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ECOLOGICAL INTEGRITY IN THE INTERIOR COLUMBIA BASIN

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INTERIOR COLUMBIA BASIN
ECOSYSTEM MANAGEMENT PROJECT

Recent Changes in Terrestrial and Aquatic Ecosystem Conditions of Subbasins within the Interior Columbia River Basin and Implications for Management

I. INTRODUCTION

When the ICBEMP was initiated the overall mission was to develop a scientifically sound, ecosystem-based strategy for management of USDA Forest Service (FS) and USDI Bureau of Land Management lands (BLM). The overall goals associated with management of FS and BLM lands are set through a complex process of legal, policy, and regulatory direction. The land ethic recently described the Chief of the Forest Service articulates the priorities and committments the Agency is making toward an ecosystem-based management approach. The land ethic ties together the concepts of sustainability of ecosystems with their health, diversity, and productivity. The management context and priorities are: 1) protect ecosystems, 2) restore deteriorated ecosystems, 3) provide multiple benefits for people, within the capabilities of ecosystems , and 4) ensure organizational effectiveness (Chiefs Course to the Future, 1995). From the scientific perspective, the ICBEMP has attempted to bring together an understanding of the capabilities of ecosystems within the project area, the current status of the ecosystems, and to describe the ecological risks and opportunities associated with attempts to achieve assumed goals.

Management of FS and BLM lands in the Interior West in this past century has produced conditions that are threatening to a variety of terrestrial and aquatic species and ecological processes. To date, resolution of these conditions has been impeded because solutions to individual issues, like forest health or salvage, have conflicted with solutions to other issues; for instance protecting habitat for endangered salmon. Forest health is often discussed separately from watershed health or salmon habitat maintenance and restoration. Often issues which should be coupled for for effective and efficient landscape managment remain separate. Thus landscape management lurches forward by emphasizing parts and scales generally far smaller than necessary to policy makers with an ecological template from which to examine strategic ecosystem management directions.

In this chapter, we report on steps used in an exercise to integrate information from several perspectives in order to answer two basic questions: 1) what are the current ecological conditions and degree of departure from historical condition in the project area, and 2) what future management opportunities and associated ecological risks present themselves that might conserve both the rich biotic diversity that typifies Interior ecosystems and future options for land management. To address these questions, we relied primarily on broadscale (1 km pixel resolution) data summarized to each subbasin to characterize vegetation structure and composition status, hydrologic functioning, degree of roaded access, and status of disturbance regimes, and subwatershed-scale information on fish communities and hydrologic resiliency also summarized to each subbasin. While this emphasis on forestland and rangeland conditions and fish status clearly does not address the full breadth of issues relevant to resource management in the ICRB, it does highlight some of the more contentous issues, and provides a spatially explicit, ecological context for consideration of management options. Our hope is that this exercise will provide a basin-scale template for a more complete and informed deliberation of resource conflicts and compatibilities between aquatic and landscape issues.

Our template examines the range of integrity of forestland, rangeland, watersheds (subbasins), and fish communities and terrestrial organism habitats. Integrity indices are defined for subbasins (on the order of 350,000 ha) by variables used and how these were combined. Common variables used to derive all integrity indices were current condition, historical departures as probable condition, and fragmentation estimates. Descriptor variables used by the different staff areas were summarized at the subbasin level for both ecological as well as data resolution and management reasons. The resolution of the data ranged from one kilometer vegetation pixels to watershed-scale (24,000 ha) fish community assemblages. Given the time and data available, the 164 subbasins in the assessment area were chosen as a compromise between the appropriate scale for such a strategic template and our ability to resolve complex basin-wide variability. The subbasin proved to be a tractable size to accurately portray divergences in fire regime and vegetation composition and structure from the lkm vegetation data. Terrestrial community groups were more appropriate at a broad spatial scale (such as the subbasin). This scale generally supports the full expression of aquatic native species and life histories that may be expected over larger areas. Also, subbasins began to approximate more complete aquatic ecosystems in most cases.

Any attempt to derive integrity indices is limited to the information at hand and risks trivializing the myriad of disturbance -- recovery cycles, synergistic interactions between environmental components and biophysical linkages, and feedback mechanisms operating on different spatial and temporal scales within the area. Nevertheless from the different staff areas came a recognition of patterns, processes and relationships. In the following sections we discuss how we define integrity and developed an understanding of assessment area conditions from separate viewpoints: aquatic, forestlands, rangelands, hydrologic and watersheds. Each of the 164 subbasins which comprise the assessment area is unique. The challenge is to identify ecologically meaningful similarities among subbasins while preserving their unique character.

We chose to organize subbasins along a set of ecological themes on forestland and rangeland that highlight the similarities between subbasins grouped within a theme. While there are substantive inter-theme differences, these themes reflect recurring patterns (emerged from the analysis) which were often coupled to common management histories and physiographic settings. Themes are not meant as a means of classifying each subbasin for a cookbook of management prescriptions. Rathkr, they are intended as simplified synthesis of common management history, resultant conditions, management opportunities, and potential ecological risks across large and complex landscapes.

Ecosystem management on the scale of the ICBEMP and its subbasins is a largely uncertain and experimental effort to maintain and restore landscape integrity, certain populations, and ecosystem types. We do not have a good track record for maintaining and restoring ecosystems within the assessment area. The template and themes examined in this chapter are necessary to provide the ecological context from which humans and their institutions and values can be integrated, and our management of ecosystems improved.

II. MEASURES OF ECOLOGICAL INTEGRITY -- UNDERSTANDING CHANGES IN BROADSCALE ECOLOGICAL CONDITIONS FROM DIFFERING PERSPECTIVES

II.1 Classifying aquatic integrity. Ecosystem management is an untested management philosophy that promotes via wise management and belief in the possibility of work sustainable biotic diversity, air and water quality, soil productivity, and flows of commodity and amenity resources for people. A management system to test the hypothesis that ecosystem management is possible does not exist, but development of such a system is a worthy goal. The stated goal of sustainable biotic diversity implies the goal of restoring integrity of degraded terrestrial or aquatic ecosystems and to provide for the long term persistence of native and desirable non-native species. Consistent with that goal is the maintenance or restoration of a mosaic of well connected, high-quality habitats that support a diverse assemblage of native species, the full expression of potential life histories and dispersal mechanisms, and the genetic diversity necessary for long-t&m persistence and adaptation in a variable environment. The concept of key watersheds has been used to identify areas that represent critical components of that mosaic that need to be conserved. Because the emphasis has been on conservation of existing condition, key watersheds are viewed by some as inflexible zones that preempt or severely curtail other management options. In reality, a wide range of management opportunity can emerge through watershed and ecosystem analysis, but that analysis often is not completed either because of a lack of resources, time, or commitment.

By itself, conservation of existing high-quality watershkds cannot meet the goals for healthy, functional aquatic ecosystems in many areas because such watersheds are too few and poorly distributed, and because natural successional processes and disturbance processes will preempt long term productivity in fixed sites. Watershed restoration will be critical to the long term health of many systems. Ecosystem management then implies more than just a system of watershed reserves, it implies using management to reestablish more complete or natural structure, function, and process whenever possible. Identical goals in terrestrial ecology, and the inextricable link between terrestrial and aquatic systems suggests that management efforts in one should benefit the other. The opportunity to work with the management of terrestrial systems rather than at odds with it is apparent, although the mechanism/process is not clear.

We propose a simple classification of subbasins throughout the ICRB to further that process. Our classification is intended to set the stage for a broadscale analysis of management needs and opportunities that can focus the need for finer scale watershed/ecosystem analysis. It is intended to facilitate the discussion of management opportunity and conflict by providing a simple but spatially explicit description of aquatic issues and needs that could be associated with similar descriptions for terrestrial ecosystems. It is not intended to be all inclusive, final or inflexible. The classification is not statistically rigorous and is based on the integration of current data as well as local'knowledge of watershed connectivity and condition that is not expressed quantitatively. Local biologists and managers often have far better information to judge the appropriate classification. This classificationis best used as a tool for communicating between disciplines as we try to identify opportunities and conflict that is likely to emerge from the multiple priorities and objectives inherent in ecosystem management.

Rather than designating large watersheds as "key" with a single set of standards, guides or default conditions common throughout, we have attempted to characterize watersheds along a gradient of conditions relative to highly functional aquatic ecosystems. For this exercise, we define highly functional systems as subbasins with a full compliment of native fish and other aquatic species, well distributed in high-quality; well connected habitats. We use subbasin as our primary classification unit because subbasins often approximate a complete system supporting most of the life-history diversity expected over larger river basins. In a sense, these subbasins approximate the boundaries of aquatic ecosystems for many of the species found within them. Subbasins that support the full expression of life histories and a strong mosaic of productive and well connected populations should be relatively self contained and resilient to the natural disturbances anticipated over biologically important time scales (100 years). (Persistence across evolutionarily important time scales implies connection across larger systems. Anadromous species additionally require the connection to the ocean through multiple subbasins.)

We use three broad categories to facilitate discussion, but recognize that a continuum of conditions really exists. Definition of conditions are inherently imprecise, but the intent should be clear **(Map 1- Aquatic Classes).**

Category 1 -- highest integrity. These subbasins most closely resemble natural, fully functional aquatic ecosystems. In general they support large, often continuous blocks of high-quality habitat and watersheds with strong populations of multiple species. Connectivity among watersheds and through the mainstem river corridor is unimpeded, and all life histories, including migratory forms, are present and important. Native species predominate, though introduced species may be present. These subbasins provide a system of large, well dispersed habitats that are resilient to large-scale catastrophic disturbances. They provide the best opportunity for long term persistence of native aquatic assemblages and may be the important sources for refounding other areas. In general, land management of these areas should be highly conservative and minimize risk to aquatic issues, (need to work with other agencies to minimize other risks as well, i.e., exotics in high lakes) . Because these areas are generally large robust enough to deal with catastrophic fire and other uncertainties, they are not the place for experimentation. Restrictions on land-use activities may have minor implications on other resource values in many of these subbasins, given that they often are associated with wilderness or other admistratively restricted lands. The Upper Middle Fork Salmon and Imnaha subbasins are examples.

Category 2 -- intermediate integrity. These subbasins support important aquatic resources, often with watersheds classified as strongholds for one or more species scattered throughout. The integrity of the fish assemblage is high or moderate. The most important difference between category 1 and category 2 is increased fragmentation that has resulted from habitat disruption or loss. These subbasins have numerous watersheds where native species have been lost or are at risk. Connectivity among watersheds exists through the mainstem river system, or has the potential for restoration of life-history patterns and dispersal among watersheds. Reestablishing the necessary mosaic of habitats will often require conservation of existing high-quality sites as well as the restoration of whole watersheds that still support remnant populations. The opportunities for conservation and restoration will rely heavily on more detailed analyses with finer-scale information. Because these subbasins often fall in some of the more intensively managed landscapes they may have extensive road networks, and the greatest need and opportunity for restoration of structure and composition of vegetation communities. There also may be opportunity to leverage active watershed restoration with active forest structural manipulation/treatment. For example, where extensive road networks exist, harvest and thinning activities might be focused over a relatively short period, and include road removal following completion. Because core watersheds that require conservative protection are scattered rather than contiguous, intensive forest management might be prioritized and focused in the matrix areas, minimizing risks to the cores. The opportunities to explore/experiment watershed restoration through active manipulation, or through attempts to produce more episodic disturbance followed by long periods of recovery (see Reeves et al. In press) are most likely in these sub-basins. Conceivably, these subbasins offer the greatest opportunity for positive solutions across multiple resource issues. The Upper Grande Ronde and North Fork-Middle Fork Boise subbasins are examples.

Category 3 -- lowest integrity. These subbasins may support populations of key salmonids or have other important aquatic values (i.e. threatened and endangered species, narrow.endemics, introduced or hatchery supported sport fisheries). In general, however, these watersheds are strongly fragmented by extensive habitat loss or disruption throughout the component watersheds, and most notably through disruption of the mainstem corridor. Major portions of these subbasins are often associated with private and agricultural lands not managed by the Forest Service or BLM. Although important and unique aquatic resources exist, they usually are localized. The opportunity for restoring connectivity among watersheds, full expression of life histories, or other large scale characteristics of fully functioning and resilient aquatic ecosystems are limited or nonexistent. Opportunities for management of aquatic resources in these subbasins primarily are in conserving remaining habitats in specific locations, rather than restoration of a more functional mosaic. Although there may be greater flexibility in land-use management for subbasin areas outside of critical watersheds, some management conflicts may arise. Because the remaining aquatic resources are often strongly isolated, the risks of local extinction may be high.

Land-use activities within these watershed may entail extreme caution not to aggravate present conditions. Conservation of the remaining productive areas may require a disproportionate contribution from federal management agencies, because these subbasins often include large areas of non-federal land. The North Fork Payette, Weiser and Boise-Mores subbasins are examples.

THIS SECTION (II.2) AND THE FIGURES AND TABLES REFERENCED HEREIN ARE UNDER REVISION. PLEASE IGNORE FIGURES AND TABLES

II.2 Classifying hydrologic disturbance, resiliency, and integrity

Estimation of hydrologic integrity across the ICRB was complicated by the lack of consistent fine-scale data for the assessment area. Stream parameters such as bankfull width, depth, gradient, and streambed substrate composition were generally lacking for most subwatersheds of the ICRB. These parameters are required if site specific quantifications of hydrologic integrity are to be made, and need to be incorporated into future integrated aquatic inventories.

A lack of tine-scale stream morphometric data for the ICRB, necessitated a more generalized probabilistic approach for use in determining subbasin hydrologic integrity in this analysis. Information concerning the resiliency of watersheds to disturbance and estimates of past management disturbance to watersheds were both used in determining the hydrologic integrity of subbasins. Rangeland and forestland subwatersheds were assessed independently in this analysis to facilitate characterization of these environments separately at the subbasin level. The following is a brief description of the methods used in this analysis to determine the hydrologic disturbance, resiliency, and integrity of forestland and rangeland environments for each subbasin.

Assessment of Hvdroloeic Disturbance

Impact variables considered to be potentially important to estimating hydrologic integrity of a subwatershed and that were available continuously across all subwatersheds of the ICRB were identified. These variables included: surficial mining, dams, cropland conversion, and roads.

To facilitate scaled comparisons of these impact variables across the ICRB, each subwatershed was assigned to an impacted or non-impacted class for each of the four impact variables studied. The percent of impacted subwatersheds within each subbasin was then calculated by impact variable type to produce a coarser-scale description of probable subbasins with impaired hydrologic function (i.e., hydrologic disturbance). The four impact variable percent values for each subbasin (i.e., mining, dams, cropland, and roads) were converted to cumulative frequency distributions which facilitated general comparisons of impact variable differences across subbasins of the ICRB (i.e., each subbasin was assigned a number between 0 and 100 which reflected the percent of other subbasins in the ICRB that had an equal or lower value for each of the four impact variables assessed).

A description of general hydrologic disturbance was constructed for the ICRB by summing all four impact variable values for each subbasin by forest and rangeland environments. This summary value for each subbasin was then converted to a cumulative frequency value which reflected overall relative hydrologic impact differences across all subbasins of the ICRB. These cumulative frequency values were converted into three hydrologic disturbanceclass ratings as follows: subbasins with values of O-33 percent were assigned to a low hydrologic disturbance class (i.e., they had the lowest overall percent impact by the four variables studied), subbasins with values of 34-66 percent were assigned to a moderate hydrologic disturbance class, and subbasins with values greater than 66 percent were assigned to a high hydrologic disturbance class. Maps were produced from these disturbance class ratings to illustrate relative hydrologic disturbance class differences between forested (Fig. 2) and rangeland (Fig. 9) environments of the ICRB by subbasin.

An assessment of probable riparian area disturbance on rangeland portions of each subbasin was also performed in this analysis. Because detailed information concerning actual riparian conditions were not available for many of the subbasins within the ICRB, riparian disturbance was estimated based on information concerning the sensitivity of streambanks to grazing (Fig. 12) and the sensitivity of stream channel function to the maintenance of riparian vegetation (Fig. 13) (see landscape ecology staff area report for more information concerning how these assessments were made). In this approach the resiliency of riparian areas to grazing was used to infer probable riparian area disturbance given the fact that most riparian areas of the ICRB have experienced historically high grazing pressure which may still persist today. Accordingly, areas with low relative grazing resiliency were considered to potentially have high riparian disturbance while areas with relatively high grazing resiliency were considered to have lower riparian disturbance. Cumulative frequency distributions were calculated for the combined streambank sensitivity and riparian vegetation sensitivity scores of each rangeland subwatershed which were then averaged by subbasin. Stratification of these cumulative frequency scores into low (O-33 percent), moderate (34-66 percent), and high (>66 percent) disturbance classes facilitated construction of a map which displays probable relative riparian area disturbance class differences of rangelands by subbasin (Fig. 10).

Assessment of Hvdroloeic Resiliency

The hydrologic and riparian disturbance ratings discussed above reflect relative management impact differences across subbasins within the ICRB. These ratings do not, however, indicate the total resiliency of such watersheds to disturbance (i.e., their ability to recover following impact). To better understand the potential hydrologic integrity of the subwatersheds and subbasins within the ICRB, a variety of resiliency ratings were developed for each subwatershed and subbasin (LE--Stars Report). These ratings are used in conjunction with the hydrologic impact ratings in the assessment of overall hydrologic integrity. For example, areas with high hydrologic'impact and high stream and riparian vegetation sensitivity are considered to have the lowest probable hydrologic integrity across the ICRB. Areas with high hydrologic impact and low stream and riparian vegetation sensitivity, however, would likely possess higher hydrologic integrity because they are better able to absorb such impacts without loss of hydrologic function. For these reasons, hydrologic resiliency ratings should always be considered when interpreting the impacts of past management activities on hydrologic integrity.

The following is a brief description of hydrologic resiliency ratings considered in this analysis:

1. ROADSTE - This hazard rating provides a relative description of areas where roads are likely to contribute sediment to streams following construction. Variables considered in this rating include: road erosion rates as interpreted by lithologic groups, and sediment transport efficiency which considers the average slope and dissection of a watershed. This variable is used in assessing potential impacts to streams following road construction and is displayed for forest lands in Figure 4 and for rangelands in Figure 14.

2. BASESED - This hazard rating provides a relative description of the sediment likely to reach a stream under conditions of no vegetation or ground cover (i.e., following wildfire or heavy vegetation extraction). Variables considered in this rating include: bare soil erosion rates and sediment transport efficiency. This variable is displayed for forest lands in Figure 5 and for rangelands in Figure 15.

3. ISFLOW - This sensitivity rating provides a relative description of watersheds where increased sediment or streamflow are likely to adversely affect stream hydrologic function. This rating is derived from an estimate of the probable stream types within a watershed and their sensitivity to increased sediment and flow. This variable is displayed for forest lands in Figure 6 and for rdngelands in Figure 16.

4. BANK - This sensitivity rating provides a relative description of watersheds where streambanks are likely to be adversely affected by management activities (i.e., areas where streambanks are sensitive to disturbance). This rating is derived from an estimate of the probable stream types within a watershed and their inherent streambank sensitivity. This variable is displayed for rangelands in Figure 12.

5. VEG - This sensitivity rating provides a relative description of watersheds where riparian vegetation is important to the maintenance of stream function. This rating is derived from an estimate of probable stream types within a watershed and their sensitivity to altered riparian vegetation. This variable is displayed for rangelands in Figure 13.

6. RECOVERY - This potential rating provides a relative description of the potential that a watershed has for recovery of hydrologic function following disturbance. This rating is derived from an estimate of probable stream types within a watershed and their potential for recovery following disturbance. This variable is displayed for forest lands in Figure 3 and rangelands in Figure 11.

The above hydrologic resiliency ratings were calculated individually for each subwatershed and subbasin. Accumulative frequency values were also calculated for each subbasin of the ICRB by forest and rangeland environments. The figures described above provide (low (O-33 percent), moderate (34-66 percent), high (>66 percent)) classes of these ratings to formulate generalized descriptions of hydrologic resiliency differences by subbasins across the ICRB.

Assessment of Hydrologic and Riparian Inteeritv

Generalized assessments of hydrologic integrity were made for the forest and rangeland environments of each subbasin by combining average cumulative frequency values for hydrologic disturbance and hydrologic recovery potential. In this analysis, hydrologic disturbance values were subtracted from 100 to make them compatible with hydrologic recovery potential ratings (i.e., high disturbance values were adjusted down to more accurately reflect their effect on hydrologic integrity calculations).

The combined values of the adjusted hydrologic disturbance and hydrologic recovery potential ratings for the forest and rangeland environment settings of each subbasin were used to produce a new cumulative frequency distribution of hydrologic integrity by subbasin. These scores were used to produce maps of relative hydrologic integrity differences across both forested (Fig. 1) and rangeland (Fig. 7) environments of the ICRB. Class ratings used in construction of these maps include low (O-33 percent), moderate (34-66 percent), and high (>66 percent) classes (i.e., the percent of other subbasins with similar or smaller hydrologic integrity values).

The relative integrity of rdngeland riparian areas was calculated in a similar manner to that used in defining general hydrologic integrity. The average relative riparian disturbance and hydrologic recovery potential ratings for each subbasin were combined in determining the probable riparian integrity value for each subbasin. Cumulative frequency distributions of these values were used to produce a map of relative riparian area integrity across the different rangeland environments of the ICRB (Fig. 8).

The integrity values described above assume that areas with high impact (disturbance) and low recovery potential (resiliency) are more likely to have higher probabilities of containing altered hydrologic functions than other areas; consequently, they are described as possessing low integrity in this report. Conversely, areas with low relative impact by mining, dams, roads, cropland conversion, and grazing and high recovery potentials are considered to have the highest probable hydrologic or riparian integrity. The integrity values presented in this report reflect probabilities of finding altered hydrologic functions within subbasins based on relative differences between subbasins. Validation of these ratings was not feasible (due primarily to the lack of appropriate fine-grain data within the ICRB). Accordingly, the hydrologic integrity, disturbance, and resiliency values presented should only be used for general planning purposes, and should not be used in prescriptive project design. Information presented in this section are appropriate to the description of relative differences across the ICRB at the subbasin level.

Application of this information to more detailed planning at the subregibnal or landscape levels of assessment may be inappropriate.

Stratification of the information described above by 6 Forestland themes and 6 Rangeland themes across the ICRB is discussed later in this report. Box plot presentations of this information are provided for forestland themes in Tables 1 through 6 and for rangeland themes in Tables 7 through 16.

II.3 Classifying forestland and rangeland integrity. We classified and spatially displayed differences in forest and range integrity of 163 subbasins of the ICRB. Integrity ratings were relative among the subbasins, and they estimated, using broadscale l-km resolution continuous data, the degree of departure of forest and range physiognomic conditions, structures, compositions, and fire disturbance regimes from that expected for the biophysical environments that comprised each subbasin. Both direct and indirect indicator variables were used in these estimations. Forest integrity ratings estimated the degree of departure of the forest component of subbasins when that component comprised at least 20 percent of the area of the subbasin. Likewise, range integrity ratings estimated the relative integrity of the range portion of subbasins when range physiognomic types comprised at least 20 percent of a subbasin.

Methods

We assessed ecological integrity of forest and rangeland ecosystems using continuous l-km resolution broadscale data summarized by subbasin. Subbasins were classified as forest subbasins if at least 20 percent of their area was comprised of forest potential vegetation groups (i.e., the sum of all forest potential vegetation types included in dry forest, moist forest, and cold forest PVGs). Similarly, subbasins were classified as rangeland subbasins if they were comprised of at least 20 percent rangeland PVGs (i.e., dry grass, dry shrub, cool shrub, woodland, riparian shrub, and riparian woodland PVGs). This rule resulted in 112 subbasins with ‘a measurable forest component and 86 subbasins with measurable range component. Five subbasins (Upper Crab, Lower Snake-Tucannon, Palouse, Rock, and Walla Walla) were comprised of 75 to 88 percent agricultural and other anthropogenic PVGs and were not classified as either forest or range. Thirty-nine subbasins werk classified as both forest. and range.

Forestland inteeritv ratings

Five variables were used to classify the integrity of forests: 1) The proportion of the forest area of subbasins in dry and moist forest PVGs ("D+M/TOT")--this variable was used to estimate the proportion of the forested area of the subbasin where ponderosa pine, Douglas-fir, western larch, western white pine, or sugar pine were the primary seral species; 2) the proportion of the subbasin having road densities estimated as moderate density and above (20.7 miles/sq. mile) "RD_MOD+"; 3) the proportion of the subbasin in wilderness areas and other unroaded or essentially unroaded ($\leq$0. 1 miles/sq. mile) areas “WILD”; 4) the proportion of the total subbasin where fire severity increased between historical (1800) and current periods ("F_SEV") by at least one class (i.e., nonlethal to mixed severity, mixed to lethal, or nonlethal to lethal); and 5) the proportion of thesubbasin area where fire frequency declined between historical to current periods ("F-FREQ") by at least one class (fire fequency classes were O-25yr interval, 26-75yr interval, 76-150yr interval, > 150yr interval).

Area in dry and moist PVGs was used as an indicator variable because empirical data from both the broadscale and midscale landscape assessments indicated that these PVGs were most affected by repeated harvest entry. Moderate and higher road densities were used as indicators of established access for timber management. Conversely, wilderness and roadless areas were used to indicate those landscapes affected primarily by the exclusion of wildfire. Increasing fire severity and declining fire frequency were used to indicate the areas where cover types and structures were likely most altered by fire exclusion and timber harvest.

Predicted departures of each variable were independently rated as high (1), moderate (2), or low (3). Categorical values for each variable were averaged to determine an average integrity value **(Table 1 and Map 2- Forest Integrity Ratings).**

Table 1. Forestland Inteoritv Ratings

Departure Value	D+M/TOT % area	F_SEV % area	F-FREQ % area	RD_MOD+ % area	WILD % area
H (1)	>66%	>66%	>66%	>66%	<25%
M (2)	**33-66%**	**33-66%**	**33-66%**	**33-66%**	**25-50%**
L **(3)**	<33%	<33%	<33%	<33%	>50%

AVERAGE FORESTLAND INTEGRITY VALUES:
Lowest = average values <1.8 (1 .O- 1.6)
Intermediate = average values 1.8 to 2.0
Highest = average values >2.0 (2.2-3.0)

Subbasins having the highest forestland integrity rating were largely unroaded, and comprised of cold forest PVGs or moist and cold forest PVGs. Only the ratings for the Wenatchee and Teton subbasins were adjusted from their original ratings. The data for the WILD and F-FREQ variables for the Wenatchee subbasin were at the breakpoint (F-FREQ = 66.6) and (WILD = 47.1). The Wenatchee subbasin was elevated from lowest to intermediate integrity by elevating the departure value for F-FREQ to moderate: Consultation with personnel in possession of field knowledge of conditions in the Teton subbasin indicated that while most of the forested component was comprised of cold forest PVGs, recent mountain pine beetle outbreaks and timber salvage had highly modified these types. Consequently, its departure value for D+M/TOT was adjusted to intermediate which lowered the overall integrity score from Highest to Intermediate.

Rangeland integrity ratings

Four variables were used to classify the integrity of herblands, shrublands, and woodlands: 1) The proportion of the rangeland area of subbasins in dry grassland and dry shrubland PVGs ("Dry/TOT"); 2) the proportion of the subbasin having road densities estimated as moderate density and above (20.7 miles/sq. mile) "RD_MOD+"; 3) the proportion of the subbasin comprised of agriculture PVGs ("AG/TOT"); 4) the proportion of the total subbasin comprised of the western juniper and big sage cover type-CRBS03 ("Juniper/TOT")

Area in dry grassland and shrubland PVGs was used as an indicator variable because empirical data from both the broadscale and midscale landscape assessments indicated that these PVGs were most affected by overgrazing and invasion of exotic grasses arid forbs. The juniper-sagebrush cover type was used instead of the woodland PVG because the latter underestimated the area affected by juniper encroachment. Moderate and higher road densities were used to indicate increasing likelihood of invasion by some exotics where incursions have been correlated with road densities. Lastly, agricultural conversion occurred primarily in range ecosystems. We assumed that conversion of range physiognomic types to agricultural types was the single greatest alteration of ICRB ranges. We estimated the extent of that conversion with the "AG/TOT" variable.

Predicted departures of each variable were independently rated as high (1), moderate (2), or low (3). Categorical values for Dry/TOT, AG/TOT, and RD_MOD+ variables were then averaged to determine an average integrity value **(Table** 2). This average value was then modified to reflect the estiimated degree of juniper encroachment. The average range integrity value was reduced by 0.67 or 0.33 when juniper areas were high or moderate, respectively. Low estimated levels of juniper encroachment did not alter integrity ratings **(Map 3- Range Integrity Ratings).**

Table 2. Raneeland Integrity Ratings

Departure Value	Dry/TOT area	AG/TOT % area	Jun/TOT % area	RD_MOD+ % area
H (1)	>66%	>25%	>15%	>66%
M (2)	33-66% .	10-25%	5-15%	33-66%
L (3)	<33%	<10%	<5%	<33%

AVERAGE RANGELAND INTEGRITY VALUES:
Lowest = average values <1.68 (1 .O- 1.67)
Intermediate = average values 1.68 to 2.66
Highest = average values >2.66 (2.67-3.0)

III. ESTIMATING BROADSCALE TERRESTRIAL COMMUNITY TYPE (HABITAT) DEPARTURES FOR RANGELANDS AND FORESTLANDS

Terrestrial community type departures were developed to estimate the magnitude of broadscale habitat changes in forestlands and rangelands within subbasins. Although we had previously estimated changes in ecological integrity of forestland and rangeland ecosystems, we could not directly interpret the effects of those changes on associated floral and fauna1 populations. Estimating broadscale habitat departures from expected historical ranges of conditions enabled us to infer risks to current and future species viablility. Habitat departure estimates are also useful for prioritizing terrestrial ecosystem restoration activities, and understanding important trade-offs and risks associated with vegetation management.

Fine scale population viability data were unavailable for most native species in the ICRB. Consequently, this information could not be aggregated for a broadscale assessment of species viability. In the absence of quantitative population viability analyses, conclusions concerning species viabilities must be largely based on inferences drawn from analyses of habitat change. We used a broadscale, coarse-filter assessment of habitat change consistent in resolution with other aspects of this integrated analysis. We compared current broadscale habitat availability within a subbasin to the range of conditions expected historically. We assumed that species persistence within a subbasin was not at risk if the current area of that species' primary habitat (as described in the SER data base, see Terrestrial Staff Area Report) fell within the 75 percent range of the historical data. We assumed risk to persistence increased substantially when current habitat availability fell below the 75 range of the historical data. Furthermore, extinction likelihood within subbasins increased when habitat availability fell below the 100 percent range of the historical data. Conversely, persistence likelihood within a subbasin increased as habitat availability exceeded the 75 percent range of the historical data.

We used 1-km'resolution continuous broadscale data, summarized by subbasin to assess habitat departures of forestland and rangeland ecosystems. We aggregated 165 cover type and structural stage combinations to 25 terrestrial community types (see Landscape Ecology Staff area report for a description of broadscale cover types and structural stages, and classification procedures for terrestrial community types). We further collapsed the forest terrestrial community types having late-seral single-layered and late-seral multi-layered structures into a "late" class. We then estimated departure from historical ranges of conditions by subbasin for 9 resulting forestland terrestrial community types (lower montane early-seral, mid-seral, and late-seral; montane (including middle and upper montane elevation settings) early-seral, mid-seral, and late-seral; and subalpine early-seral, mid-seral, and late-seral), and 3 upland rangeland types (including herblands, shrublands, and woodlands). We estimated departures for those terrestrial community types that comprised at least one percent of the subbasin area foi any output period of the historical CRBSUM model run, or for the current condition. Departure values were not determined for anthropogenic community types (for example, cropland, exotic, urban) and those that remained relatively stable between historical and current periods, such as alpine, rock, and barren community types. Departures were also not estimated for riparian community types because historical occurrence of riparian cover types was typically underestimated, and current occurrence was typically overestimated.

Terrestrial community type departures were determined by comparing the current area1 extent of each type to modeled 75 and 100 percent historical ranges of each type; five departure classes were defined **(Table 3; Terrestrial Conimunity Type Departure Classes).** Historical ranges were developed using a single 400 year run of CRBSUM for the entire ICRB, and cover type and structural stage outputs for historic years 0, 50, 100, 200,300, and 400. Initial conditions (historic year 0) for the historical CRBSUM run and their derivations are described in the Landscape Ecology Staff Area Report-Broadscale Assessment. Net change in terrestrial community type area by departure class and subbasin was summarized for rangeland and forestland themes (see Sections V and VI). We considered a net change of 1 subbasin in a departure class within a theme area to be significant.

Table 3. Terrestrial communitv departure classes.

Departure Class	**Relationship to historical ranges**
1	≥ 100% historical range
2	>75% to <100% historical range
3	within 75% historical range
4	>-75% to <-100% historical range
5	~-100% historical range

IV. FOREST AND RANGE THEME DEVELOPMENT

Central to the process of integration is the recognition of pattern, process, and relationships from a variety of perspectives. In preceding sections, we presented our understanding of ICRB conditions from separate viewpoints--aquatic, terrestrial, and hydrologic. In this and following sections, we describe a more unified view incorporating elements from each separate viewpoint that recognizes similarities and differences among and between subbasins.

Each of the 164 subbasins in the ICRB is unique. No two subbasins are indistinguishable using variables we identified as indicators of ecosystem conditions. The challenge is not to distinguish differences. There are as many differences as the number of subbasins and the number of variables used to describe them will allow. Instead, the challenge is to identify meaningful similarities among subbasins, while preserving their unique characters. Our solution was to organize subbasins along a set of ecological themes that highlight the similarities of subbasins grouped within themes, while acknowledging substantive inter-theme differences. These themes reflect recurring patterns that emerged from the aquatic and landscape analyses. Themes are not meant as a means of classifying each subbasin for a cookbook of management prescriptions, rather they are intended as a simplified synthesis of common management history, resultant conditions, management needs, opportunities, and potential conflicts across large and complex landscapes.

Theme development was driven with two objectives in mind. First, each theme should succinctly portray a well-defined ecological story. That is, theme descriptions should be coarse, but broadly accurate descriptions of ecological conditions within the member subbasins, and sufficiently dissimilar from other themes to avoid confusion. Second, theme membership should be defined following a tractable rationale that minimizes ambiguity. To that end, we used multivariate cluster analysis where possible. We were not, however, above injecting subjective, professional judgement into theme assignments when formal methods fell short.

We performed cluster analyses using descriptive variables summarized at the subbasin level. Subbasins were used as the basic sample-unit because they often (but not always) support the full expression of native species, interacting subpopulations, and life histories that may be expected over larger areas. Subbasins are often isolated from larger river basins by dams or natural barriers to species movement. In many cases, subbasins begin to approximate complete or nearly complete aquatic ecosystems.

Separate cluster analyses were used for forests and range. The selected variables and the analysis strategy used is presented with the theme discussions in following sections. Resulting clusters were used to develop two sets of dominant themes, one for forests and one for range. Because subbasins can contain substantial amounts of both range and forests, themes are not mutually exclusive or all encompassing.

--- To be Resolved ---

The mix of ecological conditions on forest and range led to a variety of combinations of forest and range themes applied to the same subbasins (**Table** 4). For forest, range, and hydrologic integrity assessments, this is not a major problem because the assessments often point to different areas within each subbasins--range or forest. The exception is the dry-forest rangelands described below. Aquatic integrity was assessed for subbasins as a whole. Thus, the discussions of aquatic conditions within each forest'or range theme refers to entire subbasins, grouped in different ways. This can be confusing. We recognize this confusion and will try to clarify the issue in the next draft of this report.

Table 4. Cross tabulation of forest and range themes. Cell counts refer to the number of subbasins within each forest- and range-theme combination. Theme designation "NC" refers to subbasins that were not classified within forest or range themes.

Range Theme	Forest Themes							
	NC	1	2	3	4	5	6	Total
N C	**0**	3	1	1	15	0	0	20
1	3	0	0	0	0	5	1	9
2	0	5	8	0	0	0	0	13
3	0	1	4	10	6	10	10	41
4	13	0	0	1	0	1	2	17
5	14	2	6	1	1	0	2	26
6	22	0	0	0	1	8	7	38
Total	52	8	18	12	8	24	22	164

V. RANGELAND THEMES

One hundred-forty-two (142) subbasins within the ICRB were classified as having substantial rangeland area if at least 20% of their area was historically comprised of grassland, shrubland, woodland, and dry forest potential vegetation types (PVGs). Rangeland subbasins comprise large proportions of most Ecological Reporting Units (ERUs) with the exception of the Northern Glaciated Mountains and the Lower Clark Fork ERU's.

European settlement converted most of the native grasslands, riparian herblands, and riparian shrublands to croplands or pasture, and dry and cool shrublands to agriculture, or opened them to domestic livestock grazing. Many remaining dry grassland and shrubland areas have been invaded by exotic grasses and forbs and the likelihood of their expansion to new areas is increasing. Conversion to agriculture has been facilitated by extensive development of irrigation systems that radically altered streamflow and channel processes. Congruent with early settlement and agricultural development, much of the current human population within the ICRB is concentrated within rangeland settings and ecotones between rangelands and dry forests. Future rural population growth will likely continue in these areas.

Range Theme Development

Range theme development followed a 3-step process that involved two separate cluster analyses. The second cluster analyses was done in order to incorporate additional information and perspectives on range themes, which go beyond that considered in the initial analysis.

Initial cluster analysis--An initial set of 85 subbasins was selected as having substantial range area if at least 20% of their area was comprised of grassland, shrubland, and woodland potential vegetation types. Five additional subbasins which were predominately grasslands historically, but have since been converted to agriculture were added to the set. Major range areas include much of the Upper Snake, Owyhee Uplands, Northern Great Basin, and Columbia Plateau Ecological Reporting Units (ERU), and non-forested regions of the Blue Mountains, Central Idaho Mountains, and Snake Headwaters. A few subbasins in the Northern and Southern Cascades, Northern Glaciated Mountains, and Upper Klamath were also identified as having at least 20% range potential-vegetation types.

We constructed a set of variables from broad-scale data that reflected vegetative conditions, hydrologic sensitivity, and anthropogenic disturbance of native range systems **(Table 5). Seven** of these variables (juniper, veg_road, hyd_road, pctcrop, dry-tot, veg, and bank) were used in a disjoint cluster analysis (SAS Institute Inc. 1989) to group subbasins into five classes based on similarity in attributes. Based on spatial distribution and distinguishing characteristics, we labeled these clusters as: 1) Central Oregon shrublands; 2) Owyhee and Snake River uplands; 3) Columbia croplands; 4) juniper woodlands; and 5) Snake River range and croplands.

Second cluster analysis--A second cluster analysis was done to address shortcomings noted in the initial step. For example, we realized that the initial set of variables and subbasins did not reflect forested range areas, which are an important component in many subbasins within the ICRB. The initial set of subbasins was supplemented by redefining range to include dry forest in addition to the grassland, shrubland, and woodland potential vegetation types. As before, range had to sum to a minimum of 20% of subbasin area before a subbasin was included. Dry forest was used ‘as an indicator of forested range as most forested range falls into that class. Adding dry-forest areas resulted in a revised set of 142 subbasins.

We constructed a second set of variables that offered a different perspective on range change from that used in the initial cluster analyses **(Table** 6). Ten of these variables (ag%, exotic%, le12%, modfire%, hifire%, allot%, urbhi%, urbmed%, bigwild%, and wooddiff; see **Table 6** for variable definitions and descriptions) were used in the clustering algorithm (SAS Institute Inc. 1989). We selected the 5-cluster structure as the most interpretable, based on mean values of input variables. .

Final themes--Range themes were constructed by combining the results of both cluster analyses; We used the first analysis as a starting point. The second analysis better identified subbasins where juniper woodlands were an appreciable segment of range and where these woodlands had expanded in area over the period between broad-scale historical and broad-scale current datasets. The second analysis also added subbasins where dry-forest range was a significant component. These subbasins were split into 2 groups: subbasins with significant proportions of unroaded area, and those without significant unroaded area.

Six themes resulted from these analyses: 1) juniper woodlands; 2) high-integrity, dry-forest range; 3) moderate-integrity, dry-forest range; 4) Columbia croplands; 5) moderate-integrity, upland shrublands; and 6) low-integrity, upland shrublands **(Map 4, Range Clusters- "Themes").**

Rangeland theme 1 -- Juniper woodlands

Synopsis - Subbasins within this them are distinguished by having large areas of western juniper (*Juniperus occidentalis*) woodland (mean juniper area of subbasins = 41%). Additionally, woodland area in each subbasin has increased substantially; average increase in juniper woodland area for the 9 subbasins is 12 percent.

Juniper woodlands are primarily found in the southwestern portion of the Columbia River Basin in a transition zone between the lower slopes of the Oregon Cascades and the intermountain basins. Juniper woodlands are also found elsewhere in the ICRB but are typically minor components of those ranges. Five of the nine subbasins comprising the "juniper woodlands" reside entirely within the Columbia Plateau Ecological Reporting Unit (ERU), 2 reside in the Upper Klamath ERU, one in the Blue Mountains ERU, and one resides partially in the Southern Cascades and Columbia Plateau ERUs.

Rangeland Conditions - Climate associated with juniper woodlands is dry, with large areas receiving 12 or fewer inches of annual average precipitation. Juniper woodlands are frequently subjected to hot, droughty summers, and cold winters. Subbasins of the juniper woodland theme are dominated by topography, soils, and climate that developed over a long period of time via successional processes involving bunchgrasses in early-seral stages, and sagebrush in mid-seral stages, occasionally leading to juniper woodlands in late-seral conditions. Late-seral structures of juniper were typically excluded by fire occurring at intervals ranging from 5 to 50 years. Areas with high surface rock, or steep broken terrain where fire did not bum uniformly, typically supported historical juniper dominated woodlands.

In the last century and a half, fire frequency has declined in at least 50% of the juniper woodland area, while fire severity has increased in 20 to 50% of the area as a direct result of effective fire prevention and suppression activities. The combined effects of fire exclusion over large areas and extensive historical (late 1800's and early 1900's) overgrazing by domestic livestock, resulted in substantial reduction in area of historical herblands and shrublands, and expansion by western juniper. Burning and harvesting of juniper woodlands to restore herbland and shrubland cover has occurred at a relatively slow rate compared with succession to woody **cover.**

Subbasins in this theme support the highest average road densities (83% of subbasin areas in road density classes moderate and above). Average area in cropland and pasture is low (8% of subbasins). The Upper and Lower Crooked River, Lost, and Goose Lake subbasins have the most dams of the range subbasins. An average of 57 percent of the area of subbasins in this theme is managed in range allotments, and an average area of 1 percent of the subbasins is managed as wilderness or roadless.

Departures in terrestrial communities - Herblands and shrublands decreased significantly within Rangeland theme 1. Herbland area decreased in 9 of 9 subbasins that exhibited the community type (net change--100% of the subbasins of the theme are below the 100% range of the historical data, **Table 7**), whereas shrublands decreased in 7 of 9 subbasins that exhibited the community type(net change--67% of the subbasins of the theme are below the 75% range of the historical data, **Table 7).** Only one subbasin (Trout) exhibited greater shrubland area than occurred historically. Juniper woodland area increased significantly. All subbasins within Rangeland theme 1 (9 of 9) currently exhibit greater western juniper woodland area than occurred historically (net change--100% of the subbasins of the theme are above the 100% range of the historical data, **Table 7).**

Implications for rangeland vertebrate species - Decline of herbland and shrubland types within Rangeland theme 1 suggests that the persistence of terrestrial vertebrates such as the western sage grouse, pygmy rabbit, Brewer's sparrow, Virginia's warbler, and loggerhead shrike is currently at risk. Conversely, increase in western juniper woodlands suggests that species such as the Plain Titmouse and Townsend's Solitaire would be favored.

Hydrologic conditions - The hydrologic integrity of these subbasins ranges from low to moderate and the riparian environment integrity is commonly low. Disturbance of hydrologic function is moderate due primarily to the development of dams, and to a lesser degree, roads and cropland conversion of valley bottoms. Grazing impacts on riparian areas can have moderate to hight impacts on the hydrologic integrity of these subbasins. The potential for streams to recover following disturbance is generally low to moderate within these subbasins. Sediment hazards associated with roads and wildfires are moderate and the sensitivity of stream channels to increased sediment and flow is high. Sensitivity of streambanks to disturbance is high and is the dependency of stream channel function to the maintenance of riparian vegetation.

Status of aquatic communities - The subbasins in this theme are included only in aquatic classes 2 (5 subbasins) and 3 (4 subbasins). The Upper and Lower Crooked River, Lower John Day, and Trout are above average in terms of native fish richness, but there is little else to suggest high aquatic integrity. The Lower Deschutes and the Upper John Day are strongholds for native rainbow/redband trout. Adjacent subbasins, Lost and Goose Lake, are quite different from each other; the Lost subbasin is perhaps the most disrupted and altered having 43 dams, and is dominated by exotic fish species. The Goose Lake subbasin has fewer dams (13) and supports widespread populations of redband trout and Pit sculpin *(Cottuspitensis),* both indicators of high water quality.

The Lower Deschutes and Upper John Day currently contain important native steelhead and Chinook salmon stocks and habitats, and dams do not preclude connecting these existing habitats with larger functional networks. These subbasins and their resident populations are key to any strategy to restore conditions for anadromous fish. The Trout subbasin (Trout Creek primarily) also contains native steelhead stocks but habitats are in poor condition. This subbasin, especially the Trout Creek mainstem, is strategically important to restoration activities intent on increasing functional networks for native Deschutes River steelhead. Dams are also absent in the Trout Creek mainstem suggesting that connection with existing functional habitats could be restored. The Lower John Day is an important corridor for anadromous salmonids but it is currently functioning primarily as a warm-water recreational (smallmouth bass) fishery.

Opportunities for management - The principal opportunity for both terrestrial and aquatic systems entails active restoration of range and riparian associated lands. Such efforts could be particularly important in the lower John Day and other subbasins in this theme that support sensitive populations of anadromous salmonids.

Forested rangelands

Forested rangelands are found in lower montane settings of the Interior Columbia River Basin on the eastern slope of the Cascade Range in Oregon and Washington, the Blue Mountains, and the west slope of the Rocky Mountains. Fourteen subbasins reside in the Central Idaho Mountains ERU, 11 reside in the Northern Glaciated Mountains ERU, three subbasins reside in the Snake Headwaters ERU, six in the Northern Cascades ERU, five in the Blue Mountains ERU, three in the Southern Cascades ERU, three in the Upper Klamath ERU, four in the Upper Clark Fork ERU, three reside all or partially in the Columbia Plateau ERU, and one in the Lower Clark Fork ERU.

Climate associated with these forested rangelands is cooler and more temperate than that of herbland, shrubland, or woodland dominated ranges; small areas of these subbasins average less than 12 inches of annual precipitation. Hot, droughty summers occur frequently, and wildfires are typically associated with protracted droughts. Fire frequency has declined in most subbasins that comprise the forested rangelands, and fire severity has increased by at least one class on 10 to 80% of the area.

Forested rangelands of these subbasins are a highly variable mosaic of forest and nonforest types distributed primarily along elevational gradients and by major changes in aspect. At lower elevations, dry forest, cool shrub, or dry grassland types occur in the uplands adjacent to valley bottoms dominated by cold forest, riparian woodland, riparian shrub, or riparian herb types. Vegetation and soils associated with these upland settings developed under the influence of frequent nonlethal fires favoring fire-tolerant coniferous species and open park-like forests, or open bunchgrass herblands with scattered shrubs. In the latter half of this century, open parklike forests of fire-tolerant conifers have developed into multi-layered closed forests as a result of fire exclusion and selective harvest practices. Bunchgrass herblands with scattered shrubs tended to a more closed shrub-dominated structure. Both changes resulted in a reduction in the amount of available forage for big game and domestic livestock. On private lands, many of the broad valleys that were historically conifer woodlands or native herblands have been developed into native or exotic perrenial pastures, hay fields, or croplands. Native ungulates were displaced from historical winter ranges to less productive ranges in adjacent montane forests.

Rangeland theme 2 -- high integrity dry-forest ranges

Synopsis - Thirteen subbasins are included in this theme. Dry forested ranges of these subbasins have been alterred by historical livestock overgrazing of the late 1880's and early 1900's, timber harvest practices, and exclusion of fire, but are among the least alterred forested rangelands of the Interior Columbia Basin. Subbasins of this theme are composed of large blocks of wilderness and minimally roaded areas (average percent wildland for subbasins = 52%).

Rangeland Conditions - Forested ranges that support domestic livestock and big game are generally in the lower elevations where livestock production often conflicts with big game management. In this century, conifers have invaded historical meadows, grassland and shrubland areas, and savannah woodlands reducing both livestock and big game forage, as well as creating elevated fuel and fire behaviour conditions.

Departures of terrestrial communities - Herblands, shrublands, and woodlands (mixed conifer and juniper) declined significantly within Rangeland theme 2. Herbland area decreased significantly in 5 of 10 subbasins that exhibited the community type (net change--16% of the subbasins of the theme are below the 75% range of the historical data), and shrubland area decreased significantly in 7 of 10 subbasins that exhibited the community type (net change--46% of the subbasins of the theme are below the 75% range of the historical data). Woodland area declined in 5 of 8 subbasins that exhibited the community type (net change--23% of the subbasins of the theme are below the 100% range of the historical data),(see **Table 7).** The loss of woodlands is most likely the result of conifer woodland progression to dry forest. Three subbasins (Lake Chelan, Lower Middle Fork Salmon, Snake Headwaters) exhibited greater herbland area than occurred historically. Two subbasins (Lower Middle Fork Salmon, Snake Headwaters) exhibited greater shrubland area, and two subbasins (Naches, Methow) exhibited greater mixed conifer woodland area than occurred historically.

Implications for rangeland vertebrate species - The decline of shrubland and herbland community types in Range theme 2 suggests that those species that rely upon ecotones between shrubland or herbland habitats and dry forests would be most affected by changes in rangeland community types in theme 2. For example,, we would expect a decline in productivity of blue grouse, mule deer and elk through loss of winter habitat. The progression of mixed-conifer woodlands to dry forests types would affect many species that prefer habitats comprised of sparse trees over more densely stocked stands. Again, forage availability for wintering deer and elk has likely declined within these subbasins. Similarly, foraging habitat for American kestrels, northern goshawks and prairie falcons has also likely declined.

Hydrologic Conditions - Hydrologic and riparian environment integrity of these subbasins is high. Past disturbances to riparian areas and hydrologic function within theme 2 has been low. Stream recovery potential from disturbances ranges from moderate to high. Sediment hazards associated with roads and wildfires tend to be some of the highest found on rangelands of the ICRB; however, the sensitivity of streams within this area to increased flow and sediment range from low to moderate. Furthermore, the dependency of stream channel function on riparian vegetation is low, as is the sensitivity of streambanks to disturbance. Consequently, these subbasins support some of the most resilient riparian environments to livestock grazing.

Status of aquatic communities - By far the best conditions in the aquatic ecosystems for rangelands are associated with the subbasins in this theme. The subbasins are dominated by aquatic class l(9) with some in class 2 (3) and a single watershed in class 3. The subbwatersheds and aquatic systems that are most degraded, however, may be associated with the lower gradient and lower elevation rangeland portions of these subbasins.

Aquatic ecosystems associated with Lower Middle Fork Salmon, Snake Headwaters, South Fork Flathead, Methow, Wenatchee, Naches, Chelan, Middle Salmon Chamberlain, Upper and Lower Selway, Hell's Canyon, and Wallowa subbasins are in good to excellent condition. Measures of fish community integrity and area in fish strongholds are among the highest found in the Basin. Virtually all of these subbasins have two or more sensitive fish species. Connectivity of subwatersheds that function as native fish strongholds is good, and strongholds for more than one species are often present in subwatersheds throughout the subbasins. Depressed fish populations are those with migratory life histories that face more hostile conditions in migratory corridors or rearing environments outside these subbasins. Diverse life histories still exist either because the historical ecosystem is still accessible, or because the expression of life history patterns is still possible within large intact portions of the aquatic ecosystem.. Fish populations and communities associated with these subbasins are among the most resilient in the ICRB and represent core distributions for many of the sensitive salmonids.

Aquatic ecosystems associated with the Similkameen subbasin are in relatively poor condition, but this subbasin is home to two sensitive fish species.

Opportunities for management - The subbasins in this theme represent the best opportunity for conservation of highly functional systems and for restoration of degraded lands in close association with more productive areas. This rangeland theme is similar to forestland theme 2. Because these lands tend to be productive and more resilient to disturbance than others there could be some opportunities to maintain commodity production with little risk to other components of the system provided they are focused in the areas least important to the aquatic system.

These subbasins can likely withstand the consequences of some large scale fires in the higher elevation cold and moist forest areas and fish populations will likely persist in the absence of management intervention. The occurrence of large scale fires in the lower elevation dry forests poses a somewhat different threat. Rivers and streams in highly dissected mountainous terrain fill with sediment after a large fire but are quickly flushed of sediment. Sediment is typically deposited in lower gradient reaches further downstream. Normally, vegetation and channel conditions would rebound quickly in such depositional zones, but these reaches'often occur on private lands, are channelized, have less than adequate streambank vegetation and channel condition because of agricultural practices and adjacent roads. From a strategic point of view, forest and watershed restoration strategies on public lands of these subbasins should consider management of vegetation and fuels in dry forests and dry forested ranges among their highest priorities.

Rangeland theme 3 -- moderate integrity dry-forest ranges

Synopsis - Forty-four subbasins are included in this theme. Dry-forest ranges of these subbasins are among the most alterred forested rangelands of the Interior Columbia Basin as a consequence of historical livestock overgrazing, timber harvest practices, and exclusion of fire. Subbasins of this theme contain little or no wilderness or roadless area (average percent wildland for subbasins = 4%). Average subbasin area in public land range allotments is 40 percent.

Rangeland Conditions - Effects of fire exclusion and overgrazing have been compounded by harvest practices in dry- forest types promoting dense, multi-layered structures with increasing cover of shade tolerant, insect and pathogen-susceptible conifers, and reduced understory shrub and herbaceous cover. Shrub and herbaceous understories are also typically less productive and diverse than they were historically. Subbasins of this theme were severely affected by extensive heavy cattle and sheep grazing in the late 1800's and early 1900's, both at low and high elevations. Many areas are beginning to recover as a result of improved livestock management, prescribed fire, and cultural treatments, but curbing expansion of introduced exotic grasses and herbs such as knapweed, leafy spurge, Kentucky bluegrass, and cheatgrass, continues to be a significant management challenge.

Forested ranges that support domestic livestock and big game are generally in the lower elevations where livestock production often conflicts with big game management. In this century, conifers have invaded historical meadows, grassland and shrubland areas, and savannah woodlands reducing both livestock and big game forage, as well as creating elevated fuel and fire behaviour conditions.

Average subbasin cropland area is 13 percent. Cropland area in most subbasins is concentrated in broad valleys associated with mainstem reaches and interior valleys of tributary streams. Exceptions are the Middle Columbia Hood, Clear-water, Franklin D. Roosevelt Lake, Lower Spokane, Hangman, and Upper Spokane subbasins which are comprised of substantially larger cropland areas (24 to 72 percent).

*Departures **of** terrestrial communities* - Herblands, shrublands, and mixed conifer woodlands declined significantly in Rangeland theme 3. Herbland area decreased significantly in 32 of 40 subbasins that exhibited the community type (net change--70% of the subbasins of the theme are below the 75% range of the historical data), while shrubland area decreased significantly in 22 of 28 subbasins that exhibited the community type (net change--47% of the subbasins of the theme are below the 75% range of the historical data). Mixed conifer woodland area declined significantly in 18 of 26 subbasins that exhibited the community type (net change--32% of the subbasins of the theme are below the 100% range of the historical data),(see **Table 7).** The loss of mixed conifer woodlands is most likely the result of conifer woodland progression to dry forest. Only the Gros Ventre, South Fork Payette, North and Middle Fork Boise, and Boise-Mores subbasins exhibited greater herbland area than occurred historically. Three subbasins (Williamson, Flathead Lake, Little Deschutes) exhibited greater shrubland area, and five subbasins (Powder, North Fork John Day, Lower Spokane, Upper Deschutes, Sprague) exhibited greater woodland area than occurred historically. Woodland area increases were the result of both juniper and mixed conifer invasion.

*Implications **for** rangelund vertebrate species* **-** The implications of observed declines in herblands, shrublands, and woodlands on terrestrial vertebrates within Range theme 3 are similar to those reported for Range theme 2. Other species in addition to those mentioned for Rangeland theme 2, that are likely adversely affected by the broadscale habitat changes observed within this theme would include Rocky Mountain bighorn sheep and mountain quail.

Hydrologic Conditions - Hydrologic and riparian environment integrity of subbasins within Range them 3 is low. Disturbance of hydrologic function by roading and mining activities, and to a lesser degree by dams and agricultural conversion, has been moderate in this area. Grazing impacts to riparian areas were assumed to be moderate in most areas. Sediment hazards associated with roads and wildfires are high and moderate, respectively. Although stream sensitivity to increased sediment and flows is generally moderate, it varies from low to high. Sensitivity of streambanks to disturbance is moderate and the dependency of stream channel function to the maintenance of riparian vegetation is commonly high. The potential for streams to recover following disturbance is moderate within these subbasins.

Status of aquatic communities - The subbasins in this theme include a broad mix of conditions for aquatic systems, but are dominated by aquatic class 2 (18 subbasins) and 3 (20 subbasins). Three subbasins were included in class 1. The North and Middle Fork Payette, Upper Klamath Lake, Upper Klamath, Little Deschutes, Upper Deschutes, and Boise-Mores subbasins are well roaded with little or no wilderness or roadless area, and support the lowest integrity fish communities (aquatic class 3). For the most part remaining native fishes populations are fragmented, represented by remnant and isolated populations scattered throughout the subbasins. Some subwatersheds within these subbasins support remnant strongholds, isolated populations of listed or sensitive species, or narrowly endemic species that will be priorities for conservation. Because non-native fish species abound, opportunities to restore functioning native ecosystems are limited. The primary opportunity for management of aquatic resources in these subbasins is likely the conservation of remnant habitats of native fishes and maintenance of high water quality contributing to desirable non-native fisheries or other recreational values. More than 50% of the area of these subbasins is on public lands.

The Middle Columbia-Hood and Klickitat subbasins stradle the Columbia River at the base of the Cascade Mountains and are therefore the represent the migration corridor for all anadromous fishes entering the Columbia River Basin. These areas contain know and predicted strong redband trout and ocean-type chinook (predicted strong bulltrout in Middle Columbia-Hood). They contain coastal cutthroat trout, coho salmon, and chum salmon (which no longer go beyond these two subbasins). They also contain the highest number of sensitive species in the assessment area, because migratory fish must pass through this corridor from the westside of the Cascades to reach the ICRB, and because a great variety of fishes cannot move past the dams.

Hydrologic and aquatic integrity in forested rangelands of the Northern Glaciated Mountains and Columbia Plateau ERUs are poor. Populations of native rainbow and bull trout are isolated and habitat is fragmented with few strongholds. Habitat in low gradient reaches is most affected by rangeland management.

Upper Clark Fork ERU forested rangeland subbasins have low to moderate watershed integrity. These subbasins contain important populations of westslope cutthroat and bull trout. Blackfoot and Bitt&root subbasins have significant numbers of isolated strongholds with potential for reconnection. The Upper Clark Fork has bull trout and westslope cutthroat trout strongholds with no potential for reconnection because of dams and mine runoff.

Forested rangeland integrity in the Gros Ventre and Salt subbasins is high; hydrologic integrity ratings are high and moderate, respectively. Yellowstone cutthroat populations are strong throughout both subbasins.

Native fishes in the Snake River, John Day River, and Upper Clark Fork River basins (Little Salmon, South Fork Salmon, North Fork John Day, Middle Fork Clearwater, and Flint-Rock) subbasins are generally found in multiple strongholds with relatively high measures of community integrity (Aquatic class 1 and class 2). The core of remaining strongholds are associated with headwaters regions and unroaded portions of the subbasins; subwatersheds are still well-connected by reasonably high quality river corridors. Productive subwatersheds may still exist in a matrix of more intensively managed lands at lower elevations, and expression of multiple life-histories makes refounding and support among populations a reasonable long-term prospect. The most degraded native fish habitats tend to be in the lower elevation dry-forest rangelands and croplands that are well roaded.

Opportunities for management - The principal opportunity in these subbasins will be to restore more functional conditions in both range and aquatic ecosystems. Where aquatic systems have have been strongly fragmented and connectivity is lost, management issues are likely to focus on the simple conservation of remaining high quality and habitats and not on restoration.

Rangeland theme 4 -- Columbia croplands .

Synopsis - Subbasins in this theme are distinguished from those of other themes by being comprised primarily of cropland and pasture (mean agriculture area of subbasins = 56%; range = 30 to SO). Subbasins of the Columbia Croplands occur in the Palouse area of eastern Washington, north central Oregon, and a small portion of north Idaho. There are 17 subbasins of which 14 are in the Columbia Plateau ERU, 2 reside in the Blue Mountains ERU, one in the Northern Cascades ERU. and 2 in the Northern Glaciated Mountains ERU.

Rangeland Conditions - Climate of these subbasins is typically dry; average area of subbasins experiencing less than 12 inches of average annual precipitation is 43 percent. Although climate of the area is relatively dry, protracted droughts do not occur as commonly in subbasins of this theme as in those of other themes, and growing seasons are fairly long.

Soils of the Columbia croplands are deep, wind-deposited loessal soils that developed with the retreat of the glaciers. Topography is gentle and much of the area is dominated by dry shrubland and dry grassland PVGs (average subbasin areas = 5 1 and 34 percent, respectively). Narrow to wide, gentle valley bottoms were once dominated by riparian woodland, riparian shrub, or riparian herb types. Most of these areas have been converted to herbaceous pasture, hay, or croplands. Small areas of native herbland and shrubland still exist where steep slopes and shallow soils predominate, or in areas protected by parks, reserves, cemeteries, or railroad rights-of way. Of the grassland and shrubland areas that have not been converted to cropland or pasture, most have been overgrazed and. invaded by exotic grass and forbs.

Rangelands in these subbasins have the lowest overall integrity of all rangelands in the ICRB. Massive irrigation systems can be found throughout much of the area, creating an extensive network of artificial canals and reservoirs. Irrigated croplands were developed in what were once dry shrubland settings. Conversely, dry croplands (primarily wheat) occur on what were once dry grassland potential vegetation types. Notable exceptions to these conversions, and subsequent loss of integrity are the large Department of Energy and Defense lands which are comprised primarily of high integrity dry shrublands.

*Departures **of** terrestrial communities* - Herblands and shrublands decreased significantly in Rangeland theme 4. Herbland area decreased in 18 of 18 subbasins that exhibited the community type (net change--100% of the subbasins of the theme are below the 75% range of the historical data; 82% of the subbasins of the theme are below the 100% range of the historical data). Loss of herblands is primarily the result of conversion to dryland agriculture. Shrubland area decreased in 13 of 17 subbasins that exhibited the community type (net change--70% of the subbasins of the theme are below the 100% range of the historical data). Loss of shrublands is primarily the result of conversion to irrigated agriculture. Only the Willow subbasin exhibited increasing area in shrubland. Mixed conifer woodland area increased in 6 of 9 subbasins that exhibited the community type (net change--29% of the subbasins of the theme are above the 75% range of the historical data),(see **Table** 7). The increase in mixed conifer woodlands is most likely the result of conifer encroachment in areas not in agricultural production. Only the Lower Snake-Asotin exhibited decreasing area in woodland.

*Implications **for** rangeland vertebrate species* - Conversion of native herblands and shrublands to agricultural types has diminished habitat for a large number of species. Current populations of Columbia sharp-tailed grouse, sage grouse, and pygmy rabbit have declined substantially and presently only occur as isolated remnants in areas such as the Department of Energy and Department of Defense Reserves in central Washington. Other species which have also likely declined due to the observed broadscale habitat changes in Range theme 4 are mountain quail and merlin. Species associated with mixed-conifer woodlands such as the American kestrel, red-tailed hawk, and Townsend's solitaire have likely increased as a whole across Range theme 4.

Hydrologic Conditions - Hydrologic and riparian environment integrity of these subbasins is low. Disturbances to hydrologic function has been dominated by the agricultural conversion of valley bottoms, and to a lesser degree, roading activities. Grazing impacts to riparian areas are assumed to be moderatet. Sediment hazards associated with roads and wildfires are moderate and low, respectively. Sensitivity of stream channels to increased sediment and flow is high, which suggests that the hydrologic integrity of many stream channels may still be impaired due to previous management activities within these subbasins. Sensitivity of streambanks to disturbance is high and the dependency of stream channel function to the maintenance of riparian vegetation is moderate. The potential for streams to recover following disturbance is the lowest of any rangeland setting within the ICRB.

*Status **of** aquatic communities* - The subbasins in this theme are strongly degraded from an aquatic perspective. They are dominated by aquatic class 3 (15 subbasins) with only two subbasins in class 2. Because it includes subbasins that contain major stretches of the mainstem Columbia and Snake Rivers, subbasins of this theme exhibit the highest mean value for native fish richness (rich4). These mainstem reaches support diverse species assemblages that include anadromous fish, making them vital migration corridors. These same stream corridors have been radically altered by hydroelectric development and now support popular reservoir fisheries for introduced specie's such as walleye *(Stizostedion vitreum)* and smallmouth bass *(Micropterus dolomieui).* Other aquatic systems have also been radically altered via the introduction of exotic fishes, as well as through dewatering and fragmentation of streams, addition of excessive sediment loads, and extensive loss of riparian cover. Most native fishes currently exist as very isolated populations (Aquatic Class 3).

The Lower Snake-Asotin, Walla Walla, and Lower Snake-Tucannon subbasins have several known and predicted strongholds for salmonids and provide habitat for steelhead trout and the federally listed stream chinook in small publically managed portions of these subbasins. The upper tributaries and reaches of the Walla Walla River contain some of the few remaining known or predicted strongholds for steelhead in the ICRB. The Upper Columbia-Priest Rapids subbasin contains the last 50 free flowing miles of the Columbia River (i.e., the Hanford reach) in the conterminous United States. This reach supports a population of margined sculpin, one of the narrow endemic fishes found in the ICBR. In addition, the Hanford reach and some adjacent tributaries contain 11 sensitive fishes.

Opportunities for management - There is little opportunity for restoration of more functional aquatic ecosystems. The primary issue for management will be conservation of localized, remnant populations of fishes or other aquatic resources. Several subbasins within the Columbia croplands theme contain critical river corridors for anadromous salmonids. There is little opportunity for a large positive influence on the condition of these corridors through management of Federal lands, but substantive improvements are possible with modification of agricultural and grazing practices adjacent to public lands. In addition, there may be opportunities to positively influence localized critical habitats for high profile species (e.g., high water quality and low temperature tributaries may represent local refuges for migrating fishes). Any opportunity to stabilize or improve water quality, water volume, and riparian conditions is important in drainages containing remnant populations.

Rangeland theme 5 -- moderate integrity upland shrublands

Synopsis - This theme is comprised of 26 subbasins which represent the bulk of the high elevation ranges. Eight subbasins reside in the Central Idaho Mountains ERU, 7 reside in the Owyhee Uplands ERU, 2 in the Snake Headwaters ERU, 2 in the Northern Cascades ERU, 4 in the Northern Great Basin ERU, 1 in the Upper Snake ERU, and 2 in the Blue Mountains ERU.

Rangeland Conditions - Shrublands in this theme although influenced by grazing and fire exclusion, are least affected by anthropogenic disturbances. They are the least roaded, contain the lowest area in cropland, and have the least number of dams of any of the rangeland themes.

Departures of terrestrial communities - Herbland habitats decreased significantly in Rangeland theme 5. Herbland area decreased significantly in 17 of 26 subbasins that exhibited the community type (net change--62% of the subbasins of the theme are.below the 75% range of the historical data),(see **Table** 7). Herbland area increased only in the Middle Salmon-Panther subbasin. Shrubland area decreased significantly in 9 of 26 subbasins that exhibited the community type (net change--4% of the subbasins of the theme are below the 75% range of the historical data. Significant increases in shrubland area were noted for 8 subbasins (Alvord Lake, Upper Quinn, East Little Owyhee, Middle Owyhee, Upper Owyhee, Upper Salmon, Big Lost, Birch), and 9 subbasins (South Fork Owyhee, Goose, South Fork Boise, Middle Salmon-Panther, Lemhi, Brownlee Reservoir, Upper Yakima, Palisades, Greys Hobock) exhibited significantly decreased shrubland area. No net change was evident in woodlands in Rangeland theme 5, but of the 21 subbasins, woodland area increased significantly in 9 subbasins, decreased significantly in 9 subbasins, and remained unchanged in only 1 subbasin.

Implications for rangeland vertebrate species - Declines in herbland and shrubland habitats observed within Rangeland theme 5 have contributed to observed declines in populations of several species of upland game birds (e.g., sage grouse, Columbia sharp-tailed grouse, and mountain quail), songbirds (e.g., Brewer's sparrow, sage thrasher, grasshopper sparrows, sage sparrow, lark bunting), raptors (e.g., burrowing owl, short-eared owl, ferruginous hawk, and loggerhead shrike), ungulates (e.g., pronghorn antelope and California bighorn sheep), and small to medium-sized mammals (e.g., Washington ground squirrel and white-tailed jack rabbits). Increased area in exotic grasses and herbs and croplands within Rangeland theme 4 has likely benetitted exotic vertebrates such as chukar partridge and ring-necked pheasant.

Hydrologic Conditions - Hydrologic and riparian environment integrity of these subbasins is high and moderate, respectively. Past disturbances to riparian areas and hydrologic function from past management activities has been relatively low. Sediment hazards associated with roads and wildfires are commonly low and moderate, respectively. Sensitivity of streams to increased sediment and flows is low. Similarly, streambank sensitivity to disturbance and the dependency of stream channel function to the maintenance of riparian vegetation are low. The potential for streams to recover following disturbance tend to be high within these subbasins. These subbasins commonly provide the fewest limitations to rangeland management from a hydrologic integrity perspective (i.e., they are resilient and have not been overly impacted in the past).

Status of aquatic communities - The conditions for aquatic ecosystems in this theme are similar to those in theme 3. Most of the subbasins are included in aquatic class 2 (14) or 3 (10). Two subbasins, the Imnaha and Greys-Hobock are in very good condition relative to other systems and are included in class 1. Subbasins support a variety of strongholds for redband trout, and some narrowly endemic fish species. Introduced species have played an important role but the integrity of most subbasins, including the Alvord Lake; Thousand-Virgin, Bruneau, Upper and Middle Owyhee, Donner and Blitzen, Camas, Upper Salmon, Pahsimeroi, Little Lost, Middle Salmon Panther, Lemhi, and Palisades remains moderate.

Several subbasins still have relatively high quality river corridors with Wild and Scenic management status; these include the Bruneau, Upper and Middle Owyhee, Upper Salmon, and Middle Salmon-Panther subbasins. Moderate or better water quality suggests that the potential for connection among some subwatersheds is still good.

Opportunities for management - Subbasins of this theme are less developed, less roaded, more remote, and tend to be less disturbed by agricultural conversion or grazing than cropland-dominated subbasins. Large areas within these upland shrublands are in cool shrubland PVGs and thus represent the best opportunity to actively resist invasion and expansion of exotic grasses and forbs. Rangelands in these subbasins tend to be more amenable to grazing and can be maintained and more likely restored to proper functioning condition. With proper grazing management practices there is also ample opportunity to restore riparian function and conserve or restore productive aquatic areas. The management opportunity for native fish is to conserve existing strongholds/or unique aquatic resources. Because of the relatively good or improving condition of many of the rangeland communities and the remaining integrity in aquatic ecosystems there is opportunity for management to benefit both. The opportunities for management in these subbasins are essentially the same as those in theme 3.

Rangeland theme 6 -- low integrity upland shrublands

Synopsis - The 38 subbasins contained in this theme are located predominantly in a broad band including much of the Snake River Plain in southern Idaho, and many subbasins of south-central Oregon. The Lower Grande Ronde subbasin is a disjunct area assigned to this theme. Theme 6 is located within portions of the Northern Great Basin, Blue Mountains, Owyhee Uplands, Upper Snake, Snake Headwaters, and Central Idaho ERUs.

Rangeland Conditions - Dry shrubland potential vegetation types dominate upland shrublands within this theme followed in importance by agriculture, dry forest and cool shrubland types (mean area of subbasins = 53%, 18%, 15%, and 1 1%, respectively). Rangeland settings of four subbasins (Burnt, Lower Grande Ronde, Middle Fork John Day River, and Silvies) are dominated by dry forest PVGs, comprising 5 1 to 63 percent of their area. The climate is generally dry and continental (mean area below 12 inches average annual precipitation class = 33%). Those subbasins with significant forest cover have relatively small areas in the 12 inch or fewer precipitation class.

Subbasins in this theme are highly alter-red as a result of historical grazing practices and fire exclusion. The dry shrubland PVG is highly sensitive to overgrazing and susceptible to invasion by exotic grasses and forbs. These areas were subjected to extensive heavy livestock grazing in the late 1800s and early 1900s. Large areas have been invaded by exotics (mean area of exotic types = 4%) or converted to crested wheatgrass and other desirable exotic grasses. Invasion of exotics is attributable to historical livestock grazing, low resiliency of dry shrublands to grazing disturbances, and relatively high road densities (mean area of subbasins with low and very low road densities = 1%).

Although agricultural development is relatively high on average, cropland area is quite variable across subbasins of this theme (mean area = 18%, range = 0 to 66 percent); relative to Oregon, subbasins in the Idahd portion of the theme are comprised of considerably greater cropland area. Most federal rangelands within this theme are currently managed as domestic livestock allotments (mean area of allotments = 68%), although natural water sources are relatively rare. Consequently, water developments are widespread, and include impoundments'as well as diversions for irrigation. Overall, rangeland integrity in subbasins within this theme range from low to moderate (28 and 10 subbasins, respectively).

Departures ***of*** *terrestrial communities* - Herblands and shrublands decreased significantly in Rangeland theme 6. Herbland area decreased significantly in 33 of 38 subbasins that exhibited the community type (net change--87% of the subbasins of the theme are below the 75% range of the historical data; 60% of the subbasins of the theme are below the 100% range of the historical data). Loss of herblands is primarily the result of conversion to agriculture and encroachment of exotic grasses and herbs. Herbland area increased significantly only in the Upper Henrys subbasin. Shrubland area decreased in 21 of 38 subbasins that exhibited the community type (net change--39% of the subbasins of the theme are below the 75% range of the historical data). Loss of shrublands is primarily the result of conversion to agriculture, change in fire regimes, increase in conifer woodlands, and encroachment of exotic grasses and herbs. Shrubland area declined significantly in 21 subbasins, increased significantly in 6 subbasins, and remained unchanged in 11 subbasins. Mixed conifer woodland area increased significantly in 17 of 29 subbasins that exhibited the community type (net change--23% of the subbasins of the theme are above the 75% range of the historical data), (see`Table 7). The increase in mixed conifer woodlands is most likely the result of conifer invasion of herbland and shrubland areas.

implications for rangeland vertebrate species - Shrubland and herbland habitats within Rangeland theme 6 have declined appreciably due to agricultural conversion and the encroachment of exotic grasses and herbs. Subsequent declines in the populations of several species (e.g., sage grouse, Brewer's sparrow, grasshopper sparrows, sage sparrow, lark bunting, burrowing owl, ferruginous hawk, loggerhead shrike, and California bighorn sheep) have been observed within this theme, and are likely attributable to these broadscale habitat changes. The overall increase of mixed-conifer woodland area across Rangeland theme 6 has likely increased habitats for American kestrels, red-tailed hawks, and Townsend's solitaire.

Hydrologic Conditions - Hydrologic integrity of these subbasins ranges from low to moderate, whereas the integrity of the riparian environments they contain is commonly low. Hydrologic function has been moderately impacted from roads, dams, mines, and cropland conversion of valley bottoms. Grazing impacts to riparian areas were assumed to range from moderate to high. Sediment hazards associated with roads and wildfire are low, and stream sensitivity to increased sediment and flow is commonly moderate. Sensitivity of streambanks to disturbance and the dependency of stream channel function to the maintenance of riparian vegetation ranges from moderate to high. The potential for streams to recover following disturbance is commonly low to moderate. Consequently, past disturbances to hydrologic integrity tend to persist within Range theme 6 for many years.

Status of aquatic communities - The subbasins in this theme represent some of the most strongly altered conditions for aquatic systems in the assessment area; 29 are included in aquatic class 3 and 8 in class (2). Aquatic communities vary between the Oregon and Idaho portions of theme 6. The dominant salmonid fish native to the Oregon portion is the redband trout. Where redband trout now persist, they generally occur in highly fragmented habitat and in isolated populations. Steelhead historically inhabited tributary basins of the Middle Snake River (e.g., Malheur and Owyhee Rivers), but are now blocked by the Hells Canyon complex of. hydroelectric dams. Water diversions have severely impacted area lakes such as Summer Lake, Lake Albert, and Warner Lakes. Many such lakes are now dominated by introduced, warm-water fishes. Threatened and sensitive fishes include several subspecies of endemic tui chubs (*Gila bicolor* ssp.), which are holding their own in relatively few places.

The Lower Grande Ronde and Middle Fork John Day River subbasins are exceptions within this theme as they both support native chinook salmon and steelhead trout. In addition to the federally listed chinook salmon, the Lower Grande Ronde contains numerous continuous strongholds of native rainbow and bull trout. Aquatic integrity of the Lower Grande Ronde is among the highest due to the presence of native fish strongholds, even though it has low forest and hydrologic integrity. Consequently, these strongholds may be short lived. The Middle Fork John Day subbasin has numerous strongholds of native rainbow and steelhead trout and has high fish community integrity; few exotic fishes have been introduced into this subbasin.

Subbasins within the Idaho portion of theme 6 are found predominantly along the mainstem and tributaries to the Middle and Upper Snake River. These subbasins exhibited the highest mean values of hyd_road, an index of road influence on hydrologic condition, and dependency on riparian vegetation for streambank stability. As a group, they tend to be below average in terms of measures of native fish community diversity and eveness, and remaining salmonid strongholds. Subbasins along the Middle Snake River above Hell's Canyon historically supported anadromous fish, but do so no longer. Upper Snake drainages were isolated historically by major falls along the Snake River and lava flows along the Snake River Plain. This has produced distinctive local faunas. Recreational fisheries throughout much of this area currently focus on introduced races of rainbow trout (0. *mykiss*) and brown trout *(Salmo trutta)* in cooler, lotic systems, and a variety of warm-water species within major reservoirs. The Big Wood subbasin is an Idaho anomaly in that it has numerous strongholds of native rainbow trout and a unique fish community assemblage. The Big Wood contains one narrowly endemic species (wood river sculpin).

Opportunities for management - In many of these subbasins, there is little hope of restoring any resemblance of historical structure and composition of aquatic communities. The prinicipal issue for managers in such areas will be the conservation of remnant or unique and often highly localized populations of native species.

VI. Forest Themes

A set of 112 subbasins was selected as having substantial forest area if at least 20% of their area was comprised of dry-forest, moist-forest, or cold-forest potential vegetation types.
We constructed a set of variables from broad-scale data that reflected vegetative conditions, hydrologic sensitivity, and anthropogenic disturbance of native forests **(Table** 8). We explored relationships between various subsets of these variables in an attempt to identify dominant ecological themes. Six conceptual themes were developed by evaluation of forest and aquatic integrity indices and summarization of variable's in **Table 8.** Two or more archetypical subbasins were identified for each conceptual theme **(Table** 9). These subbasins were selected as best representing conditions expressed by a particular theme. A subset of eight variables (firefq, firesv, veg_road, stridx, wild, int_even, drypct, and moipct) was selected that best portrayed the emergent forest themes. These data were used in a cluster analysis (SAS Institute Inc. 1989) to allocate all subbasins to one of the six themes **(Map** 5). Subbasins were assigned to the theme with the shortest distance (maximum similarity) between the subbasin and a centroid formed from an average of the archetypical subbasins for that theme. In the full development of the emergent themes we summarized or considered a variety of variables and other information to further refine similarities and differences as well as opportunities and issues. As with any arbitrary classification scheme, we saw considerable variation within themes, and some overlap across themes.

In the discussions below, we characterize the subbasins grouped within each theme using the set of indicator variables derived for this integration exercise **(table 8).** We begin each discussion with a brief synopsis. Each characterization is then organized by forest conditions, departures in terrestrial communities, implication for terrestrial vertebrate species, hydrologic conditions, status of aquatic communities, and opportunities for management. Mean values of the variables used in the clustering process highlight some of the important differences that distinguish themes **(figure** 1). The variables used in the dluster analysis were standardized such that they have a mean value of zero and standard deviation of one, when summarized for all forested subbasins. Thus, the mean values shown in **figure** 1 are expressed in standard deviation units. For example, the mean percentage of dry forest within subbasins in theme 1 is approximately 1 standard deviation below the overall mean. To aid interpretation, high positive values of variables firefq, firesv, vegroad, wild, stridx, and int_evn denote a greater resemblance to historical conditions; high negative values indicate a greater departure from historical conditions. We refer to the values depicted in **figure** 1 repeatedly in the discussions below, but also refer to additional information not shown here.

Forest theme 1 -- Wild and minimally roaded cold and moist forests.

Synopsis - These subbasins show relatively minimal loss in integrity in either forest or aquatic ecosystems. They tend to be dominated by wilderness and roadless areas and cold, or moist and cold forests. Opportunities to conserve elements of ecosystems most closely resembling natural or historical conditions are probably best in these areas.

Forest Conditions - The forest ecosystems within these subbasins are among those least altered by management. They are predominantly high elevation, and cold forest or moist and cold forest potential vegetation groups (PVGs). Forest structure and composition have been simplified primarily by fire exclusion, and little alteration has occurred as a consequence of timber harvkst. Mean changes in fire severity and frequency are the lowest among the themes. Where important changes have occurred, mixed-severity regimes have tended toward lethal regimes and fire frequency has generally declined as result of effective fire suppression.

Departures in terrestrial communities -

Lower montane environments: Area in early seral structures declined significantly in more than a third of the subbasins in Forestland theme 1 (net change--36% of the subbasins are below the 75% range of the historical data), while area in mid-seral structures increased in less than one-quarter of the subbasins (net change--18% of the subbasins are above the 100% range of the historical data). Area in late-seral structure declined in slightly more than half of the subbasins (net change--54% of the subbasins are below the 75% range of the historical data), **(see Table 10).**

Montane (middle and upper montane) environments: Area in early seral structures increased in less than one-quarter of the subbasins (net change--18% of the subbasins are above 100% range of the historical data), and significant increase in mid-seral structures occurred in approximately tine-tenth of the subbasins (net change--9% of the subbasins are above the 100% range of the historical data). Most significant of all in montane environments, area in late-seral structure declined in nearly two-thirds of the subbasins (net change--64% of the subbasins are below the 100% range of the historical data), **(see Table 10).**

Subalpine environments: Area in early seral structures increased significantly in a third of the subbasins (net change--36% of the subbasins are above 100% range of the historical data), while area in mid-seral structures increased in only a tenth of the subbasins (net change--9% of the subbasins are above the 100% range of the historical data). Again, the most significant change occurring in subalpine environments was the reduction in area of late-seral structures in three-quarters of the subbasins (net change--74% of the subbasins are below the 75% range of the historical data; 64% of the subbasins are below the 100% range of the historical data), **(see Table 10).**

Late seral structure declined significantly in all three elevation settings with compensating increases in early and mid-seral structure.

Implications for terrestrial vertebrate species -

Relatively limited road access in cold and moist forests of this theme suggests that forest habitats provide a relatively high degree of security for a variety of species vulnerable to human exploitation and/or disturbance (eg., Rocky Mountain gray wolf, grizzly bear, wolverine, lynx, moose, and elk). Decline of late-seral forest structures within moist and cold forests of this theme has likely had detrimental effects on available habitats for such species as American, marten, lynx, and boreal owl. Conversely, increased area in early-seral structures has likely increased the abundance of primarily summer foraging habitat for many forest ungulates (for example, white-tailed deer, moose, and elk).

Hydrologic conditions - Hydrologic integrity of these subbasins is the highest of any forest lands in the CRB. Disturbance of hydrologic function due to past-management activities is low and the potential for streams to recover following disturbance is generally moderate to high. Steep slopes, high drainage densities, and erosive soils are commonly found on the forested lands of these subbasins. These factors contribute to high sediment hazard potential ratings for these subbasins following roading or large crown consuming fires. Accordingly, construction of new roads should be minimized and fuel management plans should be developed to limit the risk of extensive wildfires in protecting the hydrologic integrity of these subbasins. Stream channels of these environments generally display a moderate sensitivity to increased sediment and flow.

Status ofaquatic communities - Subbasins within this theme were ranked as either high (6 subbasins) or moderate (5 subbasins) aquatic integrity. The occurrences of salmonid strongholds and the measures of fish community structure *(h-even)* are among the highest found in the ICRB. Of the possible combinations of species and subwatersheds for key salmonids, 3 1% still support strong populations. Although introduced fishes are often present, they rarely dominate communities. Connectivity among subwatersheds supporting native fish strongholds is good and strongholds for multiple species often exist in subwatersheds throughout these subbasins. Depressed populations are often taxa with migratory life-histories. (e.g. anadromous salmonds and bull trout) that face increasing threats and more hostile conditions in the migratory corridors or rearing environments outside these subbasins. Diverse life histories persist either because the historical stream network is fully accessible, or because the expression of historical life-history patterns is still possible within the remaining network (e.g. South Fork Flathead River above Hungry Horse Dam). Fish populations and communities associated with these subbasins are likely the most resilient in the ICRB, are able to withstand large-scale disturbance events, and will likely persist without any human intervention.

Opportunities for management - These subbasins require little watershed or forest restoration since they deviate relatively little from historical conditions in either forest or aquatic systems. Because these subbasins lack extensive road networks in all but the low and mid montane environments, there is currently little opportunity for intensive management. The primary managment opportunity is to conserve existing conditions. In many cases, land forms are steep, moderately to highly erosive, and sensitive to roading. Developing roaded access into these areas will be expensive and will carry a high ecological risk for existing aquatic and terrestrial communities. Where vegetation management is needed, prescribed fire presents the best opportunity to reestablish more-typical fire regimes. Both managed and natural ignitions could be used to restructure forests and natural disturbance regimes.

We ranked this group of subbasins high in risks associated with commodity (timber) production. Our assertion was based on the strong tendency for subbasins to be largely unroaded, and to occur in high elevation, cold forest potential vegetation groups (PVGs) in steep, highly dissected mountainous terrain. Increased timber production would necessitate extensive new road construction with high costs to mitigate the effects of roads or high ecological costs if mitigation failed.

We ranked this theme low in production opportunity for many of the same reasons: lack of an existing road network, high costs of mitigating the most deleterious effects of roads on terrestrial and aquatic habitats, and intermediate timber productivity relative to subbasins dominated by moist habitat types.

Forest theme 2 -- Semi-wild and moderately roaded areas.

Synopsis - These subbasins represent a mix of moderate-to-high forest and aquatic integrity. Moderate and larger blocks of wilderness or roadless areas and cold- or moist-forest types are associated with the best conditions. Landscape vegetation patterns and disturbance processes are more highly alterred in lower- and mid-montane settings. These areas typically coincide with higher road densities and a mix of both strong and unproductive watersheds.

Forest conditions - The headwater areas are likely to be primarily moist and cold forests that are least altered in structure and composition. Mid- and lower-elevation dry and moist forests have changed more substantially. Moderate (0.7- 1.7 mi./mi.^{2}) and higher road densities are probably found at lower and mid elevations in the dry- and moist-forest types. The tendency in dry forests has been to move from nonlethal to mixed and lethal fire severities with declining fire frequencies. The tendency in moist forest groups has been to move from mixed to lethal fire severity with reduced fire frequency. Forest integrity is moderate where significant areas have been accessed by roads and accessed areas are substantially modified in their structure and composition.

Depurtures in terrestrial communities -

Lower montane environments: Area in early seral structures declined significantly in three-quarters of the subbasins (net change--73% of the subbasins are below the 75% range of the historical data), while area in mid-seral structures increased significantly in well over a third of the subbasins (net change--43% of the subbasins are above the 100% range of the historical data). As in the preceeding theme, area in late-seral structures declined significantly in nearly all subbasins of this theme (net change--95% of the subbasins are below the 75% range of the historical data; 84% of the subbasins are below the 100% range of the historical data), **(see Table 10)**.

Montane (middle and upper montane) environments: Area in early seral structures decreased significantly in fewer than a tenth of the subbasins (net change--6% of the subbasins are below 100% range of the historical data), while area in mid-seral structures increased significantly in just less than a quarter of the subbasins (net change--21% of the subbasins are above the 75% range of the historical data). Area in late-seral structure declined significantly in a quarter of the subbasins (net change--27% of the subbasins are below the 100% range of the historical data), **(see Table 10).**

Subalpine environments: Area in early seral structures increased significantly in more than half of the subbasins (net change--58% of the subbasins are above 100% range of the historical data), whereas area in mid-seral structures decreased significantly in a quarter of the subbasins (net change--26% of the subbasins are below the 75% range of the historical data). Area in late-seral structures declined significantly in more than a third of the subbasins (net change--42% of the subbasins are below the 75% range of the historical data), **(Table 10).**

Late and early seral structure declined significantly in most elevation settings with compensating changes in mid-seral structure, resulting in more homogeneous forest structure.

Implications for terrestrial vertebrate species - Forests in this theme provide relatively secure habitats for those species vulnerable to exploitation and/or human disturbance (e.g., elk, American marten, gray wolf, wolverine, etc.). Risks to persistence of terrestrial vertebrates which rely heavily on early- or late-seral structures have likely increased. For example, late-seral structures preferred by northern goshawks, boreal owls, flammulated owls, American marten, and Canada lynx have declined across this theme. Similarly, species which prefer small openings of non-forest, canopy gaps, or open understories within forested environs have probably been negatively affected by the homogenization of forest structures (e.g., silver-haired bat, northern goshawk, and flammulated owls). The overall decline of early-seral forest structures has probably reduced habitat availability for dry, moist, and cold forest species such as moose, Rocky

Mountain elk, Lewis' woodpecker, black-backed woodpecker, olive-sided flycatcher, western bluebird, and western tanager.

Hydrologic conditions - Hydrologic integrity of the forests within these subbasins is relatively high. Disturbance of hydrologic function due to past management activities is generally low and the potential for streams to recover following disturbance is commonly high. Sediment hazard potentials of these subbasins are similar to Forest Theme 1 (i.e., they are high for roading and, wildfires). Accordingly, construction of new roads should be minimized and fuel management plans should be developed to limit the risk of extensive wildfires in protecting the hydrologic integrity of these subbasins. Stream channels of these environments generally display a low sensitivity to increased sediment and flow.

Status of aquatic communities - Subbasins within this themes were classified as high (8 subbasins) or moderate (11 subbasins) aquatic integrity. Population strongholds are generally associated with headwaters and unroaded portions of the subbasins, and most subbasins are intra-connected well via unimpeded river corridors. Productive subwatersheds may exist in a matrix of more intensively managed lands at lower elevations, and expression of multiple life histories makes refounding and support among populations a reasonable long-term prospect. The most degraded fish habitats are likely to be in the lower-elevation, dry and moist forests that are moderately to heavily roaded.

Opportunities for management - The primary opportunity is to conserve the integrity of the high-elevation and headwater landscapes and actively restore more productive and lower risk conditions in middle and lower elevations. Restructuring and recomposing forests would influence fire regimes at higher elevations by minimizing currently large areas of mixed and lethal five regime. Restoring subwatersheds at lower elevations will expand the interconnected mosaic of productive habitats and contribute to the stability and diversity of the aquatic ecosystem.

Because lower integrity forest and high-integrity aquatics rarely overlap, there should be relatively little conflict between management to restore forest structure and composition where needed, and conserving important fish habitats. These subbasins tend to have a mix of high and moderate forest and aquatic integrity. Moderate to large blocks of wilderness/roadless areas are associated with high integrity and consequently have little need or opportunity for intensive restoration. The greatest need for forest restoration is likely in subwatersheds with existing road networks. Managers should find opportunities for intensive restoration activities that coincide with opportunities for subwatershed restoration. Harvest and thinning activities in subwatersheds with existing road networks could generate money for active watershed restoration including the obliteration of redundant or high-risk roads. Because an assortment of productive and unproductive subwatersheds exists in the lower elevations of these subbasins, managers have the opportunity to prioritize efforts representing the least risk to strong fish populations and greatest potential gain for the forest ecosystem. Because these aquatic systems show relatively little influence of introduced species, and a collection of strong salmonid populations there is good potential for long term persistence and restoration of native species in restored or lower elevation watersheds. Active' restoration in these areas could help secure the integrity of existing strongholds by disconnecting forests prone to high severity fire and by extending the distribution of functional watersheds and strongholds into areas likely to result in increased life-history and phenotypic diversity.

These subbasins are ideal for restoration because relatively small investments could secure relatively large, diverse and functional systems. To be effective, conservation would need to address large blocks of important fish habitats that are at risk outside of wilderness and roadless areas.

These subbasins were second among the themes in risks associated with timber production, and also second highest in commodity production opportunity. The forests are productive and useful road networks already exist. Because existing fish strongholds are often. associated with wilderness blocks, and because the most productive forests often will be associated with the existing roaded networks, risks of production are less than those for the theme 1. Outside of wilderness, many areas could be ideal for upland vegetation manipulation to restore more typical and predictable fire regimes and vegetative patterns. Thoughtful access and vegetation management could secure and improve the distribution of productive terrestrial and aquatic habitats.

Forest theme 3 -- Intermediate and low-integrity forest

Synopsis - Forest and aquatic conditions in subbasins in this theme seem contradictory. The aquatic ecosystems, represented by salmonid strongholds and native species diversity, remain in relatively good condition. The forests, however, are in poor condition and appear to have changed dramatically in structure, composition -and probable fire regime. Moderate or even extensive roading and an anticipated need for intensive management to restore forest structure' and composition represent potential conflicts for conservation of terrestrial and aquatic species and habitats.

The aquatic ecosystems could be highly productive and resilient in the face of such disturbance, or the cumulative effects of disturbance in streams may simply lag behind changes in watersheds. Considering current knowledge and uncertainty of outcomes for existing fish strongholds, management to restore forest structure and composition may well represent some of the most important risks and potential conflicts for maintaining productive aquatic ecosystems. For terrestrial ecosystem restoration work to proceed in these subbasins with greater certainty of outcomes than currently exists, careful and perhaps extensive watershed analyses will be needed.

Forest conditions - The forests in these subbasins are generally in poor condition with the highest mean departures in fire frequency and severity. These subbasins often support moderate road densities with an uncertain influence on watershed conditions.

Departures in terrestrial communities -

Lower montane environments: Area in early seral structures declined significantly in the majority of subbasins (net change--85% of the subbasins are below the 75% range of the historical data), with compensating increases in area of mid-seral structures in more than half of the subbasins (net change--54% of the subbasins are above the 100% range of the historical data). Area in late-seral structures decreased in nearly all subbasins (net change--84% of the subbasins are below the 100% range of the historical data), **(Table 10).**

Montane (middle and upper montane) environments: Area occuppied by early seral structures again decreased significantly in montane environments (net change--62% of the subbasins are below 75% range of the historical data), with compensating increase in mid-seral structures (net change--62% of the subbasins are above the 100% range of the historical data). Area in late-seral structures decreased in one-quarter of the subbasins of this theme (net change--23% of the subbasins are below the 100% range of the historical data).

Subalpine environments: Area in early seral structures increased significantly in more than a third of the subbasins (net change--39% of the subbasins are above 100% range of the historical data), while area in mid-seral structures declined (net change--16% of the subbasins are below the 75% range of the historical data). As in preceeding themes, area in late-seral structures declined significantly in well over a third of the subbasins (net change--38% of the subbasins are below the 100% range of the historical data).

Areas in late and early seral structures declined most significantly with compensating changes in mid-seral structures, resulting in more homogeneous forest structure.

Implications for terrestrial vertebrate species - Road densities throughout forests within this theme are relatively high. Consequently, terrestrial species vulnerable to human disturbance and/or exploitation (e.g., elk, American marten, mountain lion) have relatively limited secure habitat. Risks to persistence of terrestrial vertebrates which rely heavily on early- or late-seral structures have likely increased. For example, late-seral structures preferred by northern goshawks, boreal owls, flammulated owls, larch mountain salamanders, and American marten have declined. Similarly, species which prefer small openings of non-forests, canopy gaps, or open forests have probably been negatively affected by the homogenization of forest structures (e.g., white-headed woodpecker, nor-them goshawk, and flammulated owls). The overall decline of early-seral forest structures has probably reduced habitat availabilities for dry and moist forest species such as Rocky Mountain elk, Lewis' woodpecker, black-backed woodpecker, olive-sided flycatcher, western bluebird, and western tanager.

Hydrologic conditions - Hydrologic integrity of these subbasins is low to moderate. Disturbance of hydrologic function from past management activities is moderate to high due in large part to roads, mines, and cropland conversion of lower-elevation valleys. The potential for streams of these environments to recover following disturbance is moderate. Sediment hazards for roads and large crown-consuming fires are moderate and the sensitivity of streams to increased sediment and flow is commonly low to moderate. These subbasins present moderate limitations to management given their hydrologic resiliency. Past activities, however, may have already contributed to degraded conditions in some subbasins, which suggests caution in future management if the hydrologic integrity of such areas is to be improved.

Status of aquatic communities - Most subbasins in this theme were classified as moderate aquatic integrity. On average, roughly one-fifth of the potential species-subwatershed combinations support strong populations of the key salmonids. Most communities are still dominated by native species. Our index of native community structure averaged the second highest among all them&. With the exception of the Bitterroot, Swan, Upper Klamath Lake and Blackfoot, all of these subbasins support sensitive populations of anadromous salmonids. The Upper Klamath supports several narrowly distributed endemic species.

Opportunities for management - Forest conditions and road densities suggest moderate or higher levels of anthropogenic disturbance. Aquatic integrity remains relatively high and/or unique species persist either because these areas are highly productive and resilient in the face of such disturbance, or because the cumulative effects of disturbance in streams may simply lag behind changes on the ground.

Subwatersheds may be vulnerable to future degradation due to existing development or dramatic changes in watershed processes from large fires that could produce extensive, synchronous changes in watershed condition. Maintaining and improving the productivity of the aquatic ecosystems and restoring forest structure and composition to conditions more typical of the biophysical environments will likely require active and intensive restoration activities. As in the previous themes there should be opportunities for restructuring forests and restoring watersheds, but there is also potential for conflict of means and ends. Because currently productive aquatic habitats strongly overlap forest conditions that could benefit from manipulation there is less opportunity to emphasize forest restoration activities in areas with little risk. Conceivably these subwatersheds have the greatest need for detailed watershed analysis and risk analysis.

These subbasins represent only a moderate opportunity for ecosystem restoration. There is potential conflict between forest and aquatic management because of fewer opportunities for simultaneous restorations with little risk to existing resources. Watersheds in poorest condition from should be treated first. Opportunities for further restoration can be guided by successes. Conservation is warranted because thse subbasins often support high-integrity fish communities and strongholds for salmonids, and because remaining sensitive populations of anadromous salmonids are at risk from watershed disturbance.

We ranked these subbasins third highest in risks associated with timber production, and third highest among the forest themes in commodity production opportunity. The forests are more likely to be productive, moist-forest PVTs, and road networks access much of the potentially productive.areas. Some areas are ideal for upland vegetation manipulation to restore more typical and predictable fire regimes and vegetative patterns.

Forest theme 4 -- Low integrity, moist forest

Synopsis - These subbasins generally exhibit low forest integrity and low or moderate aquatic integrity. They are likely to be heavily roaded and are dominated by moist, and more productive forest types. Although the aquatic systems often have the connectivity to sustain multiple life histories, the distribution of important watersheds is often fragmented, perhaps through habitat disruption associated with intensive forest management. Thk productive nature of the forests in these subbasins may imply distinct alternatives and opportunities for management.

Forest conditions - On average these subbasins have moderate to high measures of departure in the conditions of both forest and aquatic ecosystems. They are strongly dominated by moist forest types, tend to have the highest road densities found across the basin and contain little wilderness or roadless areas.

Forest structure and composition have been altered by past management. These forests generally show moderate to strong departure in fire severity, but less change in fire frequency. Natural fire patterns were historically the result of a mix of mixed and lethal severity regimes. Currently, fires are predominaty lethal and very infrequent.

Departures in terrestrial communities -

Lower montane environments: Area in early seral structures declined significantly in 19 of 20 subbasins that exhibited the community type (net change--82% of the subbasins of the theme of the theme are below the 75% range of the historical data; 78% of the subbasins of the theme of the theme are below the 100% range of the historical data). Area in mid-serdl structures declined in 12 of 22 subbasins that exhibited the community type (net change--18% of'the subbasins of the theme are below the 100% range of the historical data). Area in late-seral structures decreased significantly in 22 of 23 subbasins that exhibited the community type (net change--96% of the subbasins of the theme are below the 100% range of the historical data), **(Table 10).**

Montane (middle and upper montane) environments:
Area in early seral structures decreased significantly in 18 of 23 subbasins that exhibited the community type (net change--65% of the subbasins of the theme are below the 75% range of the historical data); compensating increase in area of mid-seral structures occurred in 20 of 23 subbasins that exhibited the community type (net change--78% of the subbasins of the theme are above the 100% range of the historical data). Area in late-seral structure declined significantly in

21 of 23 subbasins that exhibited the community type (net change--87% of the subbasins of the theme are below the 100% range of the historical data).

Subalpine environments:
Area in early seral structures decreased significantly in 8 of 20 subbasins that exhibited the community type (net change--4% of the subbasins of the theme are below 75% range of the historical data, Table VI-l), whereas area in mid-seral structures increased significantly in 2 of 23 subbasins that exhibited the community type (net change--8% of the subbasins of the theme are above the 75% range of the historical data, Table VI-l). The most significant change in subalpine types in Forestland theme 4 was to late-seral structure where significant decline was exhibited in 21 of 21 subbasins that exhibited the community type (net change--91 % of the subbasins of the theme are below the 75% range of the historical data; 87% of the subbasins of the theme are below the 100% range of the historical data, Table VI-l).

Late seral. structure all but disappeared in all elevation settings; large increases in mid-seral structure were the primary compensating change. Early seral structures also declined significantly across subbasins comprising theme 4. Consequently, forest structure is currently more homogeneous than it was historically.

Implications for terrestrial vertebrate species -
Terrestrial species vulnirable to human disturbance and/or exploitation (e.g., elk, moose, woodland caribou, lynx, fisher, mountain lion, grizzly bear, and gray wolf) have a relatively low amount of secure habitat presently available due to the extensive roaded access which has occurred within Forest theme 4 . The risks to persistence of terrestrial vertebrates which rely heavily on early- or late-seral structures within the predominantly moist forests within this theme have likely increased substantially. For example, late-seral structures preferred by Vaux's swift, northern goshawks, boreal owls, flammulated owls, and American marten have declined across this theme. Similarly, species which prefer small openings of non-forests, canopy gaps, or open forests have probably been negatively affected by the homogenization of forest structures (e.g., northern goshawk, pileated woodpecker, and flammulated owls). The overall decline of early-seral forest structures has probably reduced habitat availabilities for moist forest species such as Rocky Mountain elk, Lewis' woodpecker, black-backed woodpecker, olive-sided flycatcher, western bluebird, and western tanager.

Hydrologic conditions - Hydrologic integrity of these subbasins is moderate. Disturbance of hydrologic function from past management activities is moderate due primarily to roads and dams. The moist landscapes are often associated with relatively high-frequency rain on snow events. Where timber harvest and roading are extensive as in the Coeur d' Alene and St. Joe subbasins, peak flow events may be exaggerated resulting in aggravated channel scour and aggradation that may negatively influence some salmonids and their habitats (see Rieman and McIntyre 1993). The potential for streams to recover following disturbance is moderate. Sediment hazards associated with road construction and stand-consuming fires are moderate.

Fuel management is a priority for maintenance of hydrologic function in these subbasins, however, the use of new roads to accomplish such objectives should be limited. Sensitivity of streams to increased sediment and flow is moderate. These forest environments present some good opportunities for hydrologic integrity restoration projects.

*Status **of** aquatic communities* - Aquatic integrity in these subbasins was judged low (14 subbasins) or moderate (9 subbasins). Subwatersheds supporting strong populations of several species still exist, but fragmentation through loss of habitat appears pervasive. On average only 9% of the potential watersheds in the historical distribution of key salmonids support strong populations. Connectivity exists in the aquatic systems through some of mainstem river corridors, and migratory life histories occur in some subbasins. Reconnection of populations and the recovery of important biological diversity is possible in these systems but will require extensive watershed restoration. Most remaining strongholds are in headwaters areas, and conservation of these areas could be an important priority for any strategy intent on conserving existing aquatic condition.

*Opportunities **for** management* - Departure from historical conditions in both aquatic and forest ecosystems is associated with extensive land management and roads. Recovery of both aquatic and terrestrial ecosystems will likely require active and intensive restoration efforts. The combination of productive forests and potentially productive aquatic habitats in many subbasins make these logical areas for investment. There are opportunities for active vegetation restoration based on existing access and needs for watershed restoration, incorporating road obliteration.

The moist-forest types can likely support longer harvest rotations. The dominance of mixed and lethal fire regimes historically suggets that the historical disturbance pattern involved large, intense events with long periods of recovery. Accordingly, managers might focus restoration activities in individual subwatersheds over a short time intervals, leaving extended periods for watershed recovery. Such strategies could minimize the need for extensive, permanent road networks and allow for large-scale watershed restoration. Because these forests support high timber values the opportunity for financing restoration activities also should be good. These subbasins represent an opportunity for innovative management focusing on active manipulation often with little to risk and a lot to gain. Because of the extremely fragile nature of few remaining productive watersheds, expanding road networks to access high-volume and high-value timber stands may create conflicts in management goals for terrestrial and aquatic ecosystems. The best opportunities for management will lie in working toward simultaneous restoration of both terrestrial and aquatic systems.

These subbasins have high restoration potential with much to gain and relatively little to lose. These subbasins are a relatively low priority for conservation because they support fewer strongholds and few or no sensitive species relative to the higher priority areas.

There are relatively low risks associated with timber production. Forest vegetation conditions in subbasins in this theme are much like those in forest theme 3, but the conditions in the aquatic systems are generally worse. Road networks are highly developed, forests are mostly comprised of moist PVTs and are among the most productive in the ICRB. Much of the productive forest could be readily accessable without new road development. There will be relatively low risk to fish associated with upland-vegetation and fuels management actvities provided that work is focused in the matrix of currently degraded watersheds that support fewer critical habitats. Thoughtful management that seeks to leverage watershed restoration through forest activities could produce important benefits in these systems. We considered this theme to have the highest commodity production opportunity for the same reasons.

Forest theme 5 -- Low-integrity, dry forests

Synopsis - These subbasins closely resemble those in theme 4 in terms of both forest and aquatic integrty, but are dominated dry-forest PVTs. Although the needs for restoration are common with the preceeding group, the alternatives for management may differ with the character and productivity of the forests.

Forest conditions - These subbasins are dominated by dry-forest PVTs and show a large mean departure in fire frequency. There has been less change in fire severity. They are extensively roaded and have little if any wilderness. Nearly 90% of the subbasins in this theme ehhibit low forest integrity.

Departures in terrestrial communities -
Lower montane environments: Area in early-seral structures declined significantly in 21 of 23 subbasins that exhibited the community type (net change--9 1% of the subbasins of the theme are below the 75% range of the historical data: 87% of the subbasins of the theme are below the 100% range of the historical data). Area in mid-seral structures increased significantly in 15 of 23 subbasins that exhibited the community type (net change--37% of the subbasins of the theme are above the 75% range of the historical data), whereas area in late-seral structure declined significantly in 14 of 23 subbasins that exhibited the community type (net change--33% of the subbasins of the theme are below the 100% range of the historical data), **(Table 10).**

Montane (middle and upper montane) environments:
Area in early seral structures decreased significantly in 14 of 20 subbasins that exhibited the community type (net change--55% of the subbasins of the theme are below 75% range of the historical data), while only minor increases in mid-seral structures were noted (net change--13% of the subbasins of the theme are above the 100% range of the historical data). Contrary to observations in all other forestland themes, area in montane late-seral structure in Forestland theme 5 increased significantly in 16 of 24 subbasins that exhibited the community type (net change--42% of the subbasins of the theme are above the 100% range of the historical data).

Subalpine environments:
Area in early seral structures increased significantly in 2 of 3 subbasins that exhibited the community type (net change--4% of the subbasins of the theme are above 100% range of the historical data). Area in mid-seral structures decreased significantly in 8 of 9 subbasins that exhibited the community type (net change--29% of the subbasins of the theme are below the 75% range of the historical data), while area in late-seral structures increased significantly in 5 of 10 subbasins that exhibited the community type (net change--4% of the subbasins of the theme are above the 100% range of the historical data).

Late seral structure increased significantly in montane and subalpine settings. The large increase in montane late seral structure is the result of conversion of a variety of forest structures dominated by shade intolerant conifers to late seral structures dominated by shade tolerant conifers. Mid-seral structure increased in lower montane and montane settings.

Implications for vertebrate species -
The predominantly dry forest Forests within theme 5 have been road extensively. Consequently, relatively low amounts of isolated secure blocks of habitat persists for species subject to human exploitation and/or disturbance (e.g., American marten, elk, etc.). The substantial increase of late-seral montane forest has likely benefited those species preferring more densely stocked forests having a greater composition of shade-tolerant conifers (e.g., American marten, red-backed voles, and northern spotted owl). However, these forest changes have likely reduced the habitat available for those species preferring the more open park-like structures which frequently occurred in ponderosa pine forests (e.g., silver-haired bat, mountain quail, pileated woodpecker, white-headed woodpecker, flammulated owl, and northern goshawk). The overall decline of early-seral forest structures has probably reduced habitat

Hydrologic conditions - Hydrologic integrity of these subbasins is low to moderate. Disturbance of hydrologic function from past management activities is moderate to high due primarily to dams, and to a lesser extent roads and agricultural conversion of lower-elevation valleys. The potential for streams to recover following disturbance is generally low, which suggests that adverse impacts of previous activities on hydrologic function are still apparent in many subbasins. Due to the gentler slopes, lower dissection, and less erosive soils of these environments, sediment hazards associated with roads and large, crown-consuming fires are generally low. Sensitivity of streams to increased sediment and flow, however, is high. This suggests that management activities that have the potential for introduction of increased sediment or runoff to stream channels be evaluated carefully.

St&us of aquatic communities - Changes in the aquatic system are most apparent in the relatively poor distribution of subwatersheds (9% on average) supporting strong populations. These subbasins predominantly exhibit low (13 subbasins) and moderate (10 subbasins) aquatic integrity. Our measure of community structure was near the mean for all subbasins, suggesting that introduced fishes are important, but they do not necessarily dominate fish communities. The subbasins associated within the Grande Ronde and John Day river basins were in better condition than average, supporting from 15% to 30% of the potential salmonid subwatersheds in a strong condition. Several of the subbasins in this cluster (i.e. Lower Dechutes, Upper and Lower Grande Ronde, Umatilla, and the Upper, Middle and North forks of the John Day) support sensitive populations of anadromous salmonids (the latter three subbasins support endangered chinook salmon). Others support one or more of the narrowly distributed endemic species.

Opportunities for management - The need for restoration is similar to theme 4, but active forest management will likely require more frequent entry and the maintenance of more extensive road systems. Forests are less productive than those associated with forest theme 4, and historical disturbance regimes imply the need of more frequent silvicultural and prescribed fire treatments . Timber values will not support helicopter yarding operations as often as in more productive areas, and more extensive road networks are likely needed in the long-term to facilitate active management (although not of the density that currently exist). Because existing road densities are very high, there may still be an important opportunity for intensive forest restoration and the subsequent elimination of unnecessary roads. Many of the subbasins exhibit low to intermediate sensitivity to erosion, and large areas are amenable to tractor logging. Because productive watersheds are often patchy in distribution there may be opportunities to focus work with little risk of further disrupting critical areas. Winter logging activities may substantially reduce deleterious effects in sensitive areas. Restoration activities that use existing road networks and elimination of roads most deleterious to key watersheds hold the most promise for improving aquatic habitat conditions.

These subbasins show moderate opportunities for restoration. Although there is a large need in both forest and aquatic ecosystems, active restoration may be more difficult to finance because of lower timber values and less productive forests. We also viewed the subbasins in this theme as a moderate priority for conservation. Although the number and distribution of strongholds is relatively poor, and the opportunity for reconnecting watersheds often limited (similar to that in theme 4), many of these subbasins support sensitive anadromous or narrowly distributed endemic species.

This theme has moderate risks associated with timber production and moderate commodity production opportunities. Forest vegetation conditions of subbasins in this theme are much like those in forest theme 4, and wilderness or unroaded blocks are essentially absent or minimally present.' Native-fish strongholds are often poorly distributed, leaving a matrix of lands with relatively little risk for active management. Road networks are highly developed and upland vegetation and fuels management actvities could proceed from existing road networks with relatively little risk to existing strongholds, provided that activities were focused in that matrix of more degraded watersheds. The active elimination of unnecessary roads could further mitigate those risks. The forests are only modestly productive. Forests could benefit significantly from vegetation and fuels management to restore more typical and predictable fire regimes and vegetative patterns.

Forest theme 6 -- Mixed-integrity dry and moist forests with low aquatic integrity.

Synopsis - The final group of subbasins were defined primarily based on low aquatic integrity. The aquatic systems tend to be especially fragmented and remaining populations of native species are often isolated. The subbasins seem to support few and widely scattered strongholds and the poorest measures of condition for fish communities. There will be little chance for recreating fully connected systems either because habitats are seriously degraded or because remaining populations are strongly isolated.

Forest conditions - Forests in these subbasins are simjlar in composition and departure from historical condition to those in theme 5, though there is higher percentage of subbasins with moderate (18%) and high (23%) forest integrity. There also is a greater mix of dry and moist forests, and the change in fire frequency is not as dramatic. Roading is less extensive than in either of the two preceeding themes

Departures in terrestrial communities - Lower montane environments:
Area in early seral structures declined significantly in 17 of 18 subbasins that exhibited the community type (net change--77% of the subbasins of the theme are below the 75% range of the historical data). Area in mid-seral structures increased in 11 of 18 subbasins that exhibited the community type (net change--28% of the subbasins of the theme are above the 100% range of the historical data), while area in late-seral structures declined significantly in 18 of 20 subbasins that exhibited the community type (net change--82% of the subbasins of the theme are below the 75% range of the historical data; 73% of the subbasins of the theme are below the 100% range of the historical data), **(Table 10).**

Montane (middle and upper montane) environments:
Area in early seral structures decreased significantly in 13 of 22 subbasins that exhibited the community type (net change--39% of the subbasins of the theme are below 100% range of the historical data), while area in mid-seral structures increased significantly in 12 of 22 subbasins that exhibited the community type (net change--32% of the subbasins of the theme are above the 75% range of the historical data). Area in late-seral structures decreased significantly in 16 of 22 subbasins that exhibited the community type (net change--54% of the subbasins of the theme are below the 100% range of the historical data).

Subalpine environments:
Area in early seral structures increased significantly in 6 of 13 subbasins that exhibited the community type (net change--18% of the subbasins of the theme are above the 75% range of the historical data), while area in mid-seral structures decreased significantly in 6 of 15 subbasins that exhibited the community type (net change--4% of the subbasins of the theme are below the 100% range of the historical data). Area in late-seral structures declined significantly in 11 of 16 subbasins that exhibited the community type (net change--41% of the subbasins of the theme are

below the 75% range of the historical data). Late and early seral structure declined significantly in lower montane and montane settings in this forestland theme with compensating changes in mid-seral structure resulting in more homogeneous forest structure.

Among all forest themes, late- and early-seral structures declined in most elevation settings; these were the most significant changes occurring in terrestrial community types. The most common compensating change was an increase in mid-seral structure, resulting in an overall homogenization of forest structure. Simplification of forest structure was most apparent in the lower montane and montane settings.

Implicationsfor terrestrial vertebrate species - Terrestrial species vulnerable to human disturbance and/or exploitation (e.g., elk, moose, , mountain lion, grizzly bear, and gray wolf) have a relatively low amount of secure habitat presently available due to the existing development of roaded access. The risks to persistence of terrestrial vertebrates which rely heavily on early- or late-seral structures within the forests within this theme have likely increased substantially. For example, late-seral structures preferred by American marten, Vaux's swift, northern goshawks, and flammulated owls have declined across this theme. Similarly, species which prefer small openings of non-forests, canopy gaps, or open forests have probably been negatively affected by the homogenization of forest structures (e.g., northern goshawk, pileated woodpecker, and flammulated owls). The overall decline of early-seral forest structures has probably reduced habitat availabilities for forest species such as Lewis' woodpecker, black-backed woodpecker, olive-sided flycatcher, western bluebird, and western tanager.

Hydrologic conditions - Hydrologic integrity of these subbasins is the lowest of any forest lands in the ICRB. Disturbance of hydrologic function from management activities is high due primarily to roads, dams, and cropland conversion of lower elevation valleys. The potential for streams to recover following disturbance is low to moderate, which suggests that adverse impacts of previous activities on hydrologic function are still apparent in many subbasins of this forest type. Sediment hazards associated with roads are moderate to high; however, those associated with large crown fires are generally low to moderate. Sensitivity of streams to increased sediment and flow in these subbasins is generally low.

Status ofaquatic communities - These subbasins show still the poorest overall condition of aquatic systems. Nineteen of twenty-two subbasins in this theme show low aquatic integrity; the remainder show moderate integrity. The mean measure of community structure (*int_even)* was the lowest of any theme, indicating that introduced fishes have had a strong influence on the communities in these subbasins. For the most part, remaining native fishes are represented by remnant and isolated populations scattered throughout the subbasins. Fragmentation of aquatic habitats may be related in part to a strong influence by agricultural development on private land. Some subwatersheds within these subbasins support isolated populations of listed or sensitive species, or narrowly distributed endemic species. Anadromous fishes are relatively unimportant. These subbasins still support strong populations of the key salmonids (10% of potential), but they are often redband trout that seem to be more resistent to disturbance and isolation. Because non-native fish species abound, and because fragmentation is strong, opportunities to restore fully functioning aquatic ecosystems, are probably limited. Exceptions to this general picture exist within the Big Wood and Salt, subbasins that support 23%, and 27% respectively of the potential subwatersheds in a strong condition for key salmonids. The Wood is strongly fragmented by irrigation diversions, but the upper portion of the basin still supports a broad distribution and relatively well-connected network of habitats. The Salt is an important basin for Yellowstone cutthroat trout. Both subbasins also have a substantial wilderness or unroaded areas that may contribute to a better condition in those systems.

Opportunitiesfor management - The primary opportunity for management of aquatic resources may be the conservation of remnant habitats of native fishes and maintenance of high water quality contributing to desirable non-native fisheries or other recreational values. Management is these areas would resemble a system of subwatershed reserves with little constraint or conflict among management priorities in the matrix, and correspondingly little opportunity for restoring more ecologically functional aquatic systems. Exceptions may occur in subbasins dominated by non-federal ownership with important subwatersheds isolated on federal land. Because remaining intact aquatic ecosystems are found primarily on federal land, and because these lands represent a small area of these subbasins, flexibility in management may be limited.

We viewed these subbasins as low priorities/opportunties for conservation or restoration because the primary option will often be the conservation of remnant habitats and populations rather than large, connected systems.

We considered this theme the lowest in risks associated with timber production. Forest vegetation conditions of subbasins in this theme are much like those in forest theme 5, and wilderness or unroaded areas are absent or minimal. Native fish strongholds are poorly distributed and the likelihood of developing widely distributed fish strongholds is low. Road networks are reasonably well developed, forests are comprised of a wide variety of dry, moist, and cold forest PVG's, are of average or below average productivity. There is often low or clearly isolated/focused risk.to fish associated with upland vegetation and fuels management actvities. Forest restoration activities could represent low risks to the remaining critical aquatic habitats or the distribution of sensitive species, assuming they are sited with recognition of those areas. Some conflict may emerge where Federal ownership is limited and critical habitats occur principally on those lands.

We considered this theme a low priority among the forest themes in commodity production opportunity because forests of most subbasins are only modestly productive. Roads networks do exist however, and some forests would benefit significantly from vegetation and fuels management to restore more typical and predictable fire regimes and vegetative patterns.

‘able 5. Initial variable set used to characterize rangeland conditions within ICRB subbasins.

Variable Name	Description	Comments
dry-tot	total of dry potential vegetation groups	1, 2
juniper	percent juniper woodlands	1, 2
pctcrop	percent cropland	3
veg_road	index of road ‘influence on vegetation	2
hyd_road	index of roading impacts on hydrologic function	3
veg	vegetation influence rating	3
bank	streambank erosion hazard rating	3
dams*	number of dams within watershed	4
mines*	number of mines within watershed	3
rich4*	relative native fish richness	5
stridx*	relative index of fish population strongholds	5
int_evn*	index of fish community diversity and evenness	5

Comments:

* These variables were not used to define cluster membership.

1. Applies only to rangeland portion of watershed.
2. Elements of range integrity measure.
3. Elements of hydrologic integrity.
4. Includes dams with more than 50 ac-ft of storage.
5. Components used in calculation of fish community integrity, see Aquatics STAR for details.

Table 6. Second variable set used to characterize rangeland conditions within ICRB subbasins.

Variable Name	Description	Comments
ag%	percent area of agriculture cover type	
exotic%	percent area of exotic species cover type	
le12%	percent area in 12 inch or less precipitation class	
modfire%	percent area in moderate fire intensity/risk class	
hifire%	percent area in high fire intensity/risk class	
allot%	percent area in federal grazing allotments	
dams*	number of dams within subbasin	1
impound*	ratio of impoundment length to stream length (??)	
urbhi%	percent area in high human population density class	
urbmed%	percent area in medium human population density class	
bigwild%	percent area in road density classes 0 and 1	
wooddiff	change in juniper woodland cover type percent area	

Comments:

* These variables were not used to define cluster membership.

1. Includes dams with more than 50 ac-ft of storage.

Table &-Variables used to characterize forestland conditions within ICRB subbasins.

Variable Name	Description	Comments
cldpct*		
dams*	number of dams within a subbasin	
drymois*		
drypct		
firefq	fire frequency index?	
firesv	fire severity	
hyd_road*	index of roading impacts on hydrologic function	
int_evn	index of fish community diversity and evenness	
mines*	number of mines within a subbasin	
moipct		
pctcrop*	percent cropland	
rich4*	relative native fish richness	
strg_len*		
stridx	relative index of fish population strongholds	
veg_road	index of road influence on vegetation	
wild	percent area of wilderness in subbasins	

Table g--Archetypical subbasins used as cluster seeds in the forest-theme cluster analysis.

Cluster	HUC4	**Subbasin** Name
1	17060206	Lower Middle Fork Salmon
	17040101	Snake Headwaters
	17010209	South Fork Flathead
2	17010202	Flint-Rock
	17060101	Hells Canyon
	17060102	Imnaha
	17020011	Wenatchee
3	17070106	Klickitat
	17060106	Lower Grande Ronde
	17010211	Swan
	17060105	Wallowa
4	17010213	Lower Clark Fork
	17060308	Lower North Fork Clearwater
5	17070306	Lower Deschutes
	17070202	North Fork John Day
	18010202	Sprague
	17060104	Upper Grande Ronde
6	17020003	Colville
	17010307	Lower Spokane
	17050122	Payette

Table 7-- Terrestrial community type departures of rangeland themes.

Range Theme Membership	Terrestrial Community Type	Departure Class	Subbasin Count	Theme Area Percent
1	Herbland	1	9	100
1	Shrubland	1	6	66.6667
1	Shrubland	2	1	11.1111
1	Shrubland	3	1	11.1111
1	Shrubland	5	1	11.1111
1	Woodland	5	9	100
2	Herbland	1	4	30.7692
2	Herbland	2	1	7.6923
2	Herbland	3	2	15.3846
2	Herbland	5	3	23.0769
2	Shrubland	1	3	23.0769
2	Shrubland	2	4	30.7692
2	Shrubland	3	2	15.3846
2	Shrubland	5	1	7.6923
2	Woodland	1	5	38.4615
2	Woodland	3	1	7.6923
2	Woodland	5	2	15.3846
3	Herbland	1	31	75.6098
3	Herbland	2	1	2.439
3	Herbland	3	4	9.7561
3	Herbland	5	4	9.7561
3	Shrubland	1	16	39.0244
3	Shrubland	2	6	14.6341
3	Shrubland	3	3	7.3171
3	Shrubland	5	3	7.3171
3	Woodland	1	16	39.0244
3	Woodland	2	2	4.878
3	Woodland	3	3	7.3171
3	Woodland	4	3	7.3171
3	Woodland	5	2	4.878
4	Herbland	1	14	82.3529
4	Herbland	2	3	17.6471
4	Shrubland	1	13	76.4706
4	Shrubland	3	3	17.6471
4	Shrubland	5	1	5.8824
4	Woodland	1	1	5.8824
4	Woodland	3	3	17.6471
4	Woodland	4	1	5.8824
4	Woodland	5	5	29.4118
5	Herbland	1	9	34.6154
5	Herbland	2	8	30.7692
5	Herbland	3	8	30.7692

Range Theme Membership	Terrestrial Community Type	Departure Class	Subbasin Count	Theme Area Percent
5	Herbland	5	1	3.8462
5	Shrubland	1	5	19.2308
5	Shrubland	2	4	15.3846
5	Shrubland	3	9	34.6154
5	Shrubland	4	4	15.3846
5	Shrubland	5	4	15.3846
5	Woodland	1	7	26.9231
5	Woodland	2	2	7.6923
5	Woodland	3	3	ii.5385
5	Woodland	5	9	34.6154
6	Herbland	1	24	63.1579
6	Herbland	2	9	23.6842
6	Herbland	3	4	10.5263
6	Herbland	5	1	2.6316
6	Shrubland	1	la	47.3684
6	Shrubland	2	3	7.8947
6	Shrubland	3	11	28.9474
6	Shrubland	4	5	13.1579
6	Shrubland	5	1	2.6316
6	Woodland	1	5	13.1579
6	Woodland	2	3	7.8947
6	Woodland	3	4	10.5263
6	Woodland	4	2	5.2632
6	Woodland	5	15	39.4737

Table 10-- Terrestrial community type departures of forestland themes.

Forest Theme Membership	Terrestrial Community Types Elevation Setting	Seral Status	Departure Class	Subbasin Count	Theme Area Percent
1	Lower	Early	1	2	18
1	Lower	Early	2	3	27
1	Lower	Early	5	1	9
1	Lower	Mid	1	3	27
1	Lower	Mid	5	5	45
1	Lower	Late	1	5	45
1	Lower	Late	2	1	9
1	Lower	Late	3	2	18
1	Montane	Early	1	3	27
1	Montane	Early	3	3	27
1	Montane	Early	5	5	45
1	Montane	Mid	1	3	27
1	Montane	Mid	3	4	36
1	Montane	Mid	5	4	36
1	Montane	Late	1	8	73
1	Montane	Late	3	2	18
1	Montane	Late	5	1	9
1	Subalpine	Early	1	3	27
1	Subalpine	Early	3	1	9
1	Subalpine	Early	5	7	64
1	Subalpine	Mid	1	5	45
1	Subalpine	Mid	5	6	55
1	Subalpine	Late	1	8	73
1	Subalpine	Late	2	1	9
1	Subalpine	Late	3	1	9
1	Subalpine	Late	5	1	9
2	Lower	Early	1	13	68
2	Lower	Early	2	2	11
2	Lower	Early	3	2	11
2	Lower	Early	4	1	5
2	Lower	Mid	1	3	16
2	Lower	Mid	3	4	21
2	Lower	Mid	5	11	58
2	Lower	Late	1	16	84
2	Lower	Late	2	2	11
2	Montane	Early	1	6	32
2	Montane	Early	2	1	5
2	Montane	Early	3	6	32
2	Montane	Early	4	1	5
2	Montane	Early	5	5	26
2	Montane	Mid	1	6	32
2	Montane	Mid	3	3	16

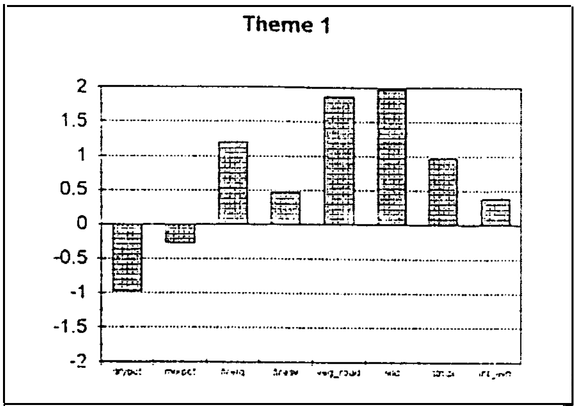
Forest Theme Membership	Terrestrial Community Types Elevation Setting	Seral Status	Departure Class	Subbasin Count	Theme Area Percent
2	Montane	Mid	5	10	53
2	Montane	Late	1	11	58
2	Montane	Late	3	2	11
2	Montane	Late	4	1	5
2	Montane	Late	5	5	26
2	Subalpine	Early	1	2	11
2	Subalpine	Early	3	3	16
2	Subalpine	Early	5	13	68
2	Subalpine	Mid	1	9	47
2	Subalpine	Mid	2	2	11
2	Subalpine	Mid	3	2	11
2	Subalpine	Mid	4	1	5
2	Subalpine	Mid	5	5	26
2	Subalpine	Late	1	10	53
2	Subalpine	Late	2	2	11
2	Subalpine	Late	3	3	16
2	Subalpine	Late	5	4	21
3	Lower	Early	1	11	85
3	Lower	Early	2	1	8
3	Lower	Early	5	1	8
3	Lower	Mid	1	2	15
3	Lower	Mid	2	1	8
3	Lower	Mid	4	1	8
3	Lower	Mid	5	9	69
3	Lower	Late	1	12	92
3	Lower	Late	5	1	8
3	Montane	Early	1	9	69
3	Montane	Early	2	1	8
3	Montane	Early	3	1	8
3	Montane	Early	5	2	15
3	Montane	Mid	1	2	15
3	Montane	Mid	3	1	8
3	Montane	Mid	5	10	77
3	Montane	Late	1	8	62
3	Montane	Late	5	5	38
3	Subalpine	Early	1	2	15
3	Subalpine	Early	5	7	54
3	Subalpine	Mid	1	3	23
3	Subalpine	Mid	2	1	8
3	Subalpine	Mid	3	4	31
3	Subalpine	Mid	5	2	15
3	Subalpine	Late	1	6	46
3	Subalpine	Late	3	2	15
	Subalpine	Late	5		

Forest Theme Membership	Terrestrial Community Types Elevation Setting	Seral Status	Departure Class	Subbasin Count	Theme Area Percent
4	Lower	Early	1	18	78
4	Lower	Early	2	1	4
4	Lower	Early	3	1	4
4	Lower	Mid	1	12	52
4	Lower	Mid	3	2	9
4	Lower	Mid	4	1	4
4	Lower	Mid	5	7	30
4	Lower	Late	1	22	96
4	Lower	Late	3	1	4
4	Montane	Early	1	15	65
4	Montane	Early	2	3	13
4	Montane	Early	3	2	9
4	Montane	Early	5	3	13
4	Montane	Mid	1	2	9
4	Montane	Mid	3	1	4
4	Montane	Mid	5	20	87
4	Montane	Late	1	21	91
4	Montane	Late	3	1	4
4	Montane	Late	5	1	4
4	Subalpine	Early	1	7	30
4	Subalpine	Early	2	1	4
4	Subalpine	Early	3	5	22
4	Subalpine	Early	5	7	30
4	Subalpine	Mid	1	5	22
4	Subalpine	Mid	2	2	9
4	Subalpine	Mid	3	6	26
4	Subalpine	Mid	4	1	4
4	Subalpine	Mid	5	8	35
4	Subalpine	Late	1	20	87
4	Subalpine	Late	2	1	4
5	Lower	Early	1	21	88
5	Lower	Early	2	1	4
5	Lower	Early	3	1	4
5	Lower	Mid	1	6	25
5	Lower	Mid	3	2	8
5	Lower	Mid	4	1	4
5	Lower	Mid	5	14	58
5	Lower	Late	1	14	58
5	Lower	Late	3	3	13
5	Lower	Late	5	6	25
5	Montane	Early	1	10	42
5	Montane	Early	2	4	17
5	Montane	Early	3	5	21
5	Montane	Early	5	1	4

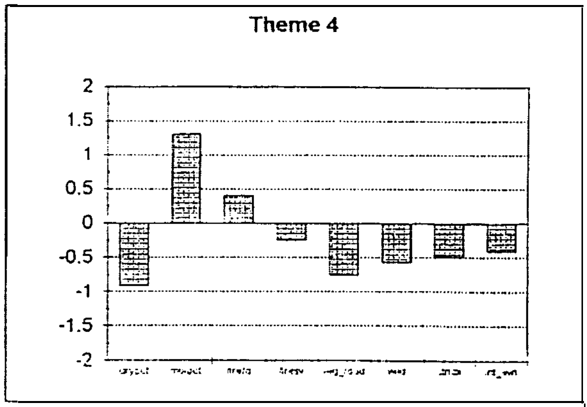
Forest Theme Membership	Terrestrial Community Types Elevation Setting	Seral Status	Departure Class	Subbasin Count	Theme Area Percent
5	Montane	Mid	1	8	33
5	Montane	Mid	2	1	4
5	Montane	Mid	3	3	13
5	Montane	Mid	4	1	4
5	Montane	Mid	5	11	46
5	Montane	Late	1	5	21
5	Montane	Late	2	1	4
5	Montane	Late	3	2	8
5	Montane	Late	5	16	67
5	Subalpine	Early	1	1	4
5	Subalpine	Early	5	2	8
5	Subalpine	Mid	1	7	29
5	Subalpine	Mid	2	1	4
5	Subalpine	Mid	5	1	4
5	Subalpine	Late	1	4	17
5	Subalpine	Late	3	1	4
5	Subalpine	Late	5	5	21
6	Lower	Early	1	15	68
6	Lower	Early	2	2	9
6	Lower	Early	3	1	5
6	Lower	Mid	1	1	5
6	Lower	Mid	2	4	18
6	Lower	Mid	3	2	9
6	Lower	Mid	4	1	5
6	Lower	Mid	5	10	45
6	Lower	Late	1	16	73
6	Lower	Late	2	2	9
6	Lower	Late	3	2	9
6	Montane	Early	1	12	55
6	Montane	Early	2	1	5
6	Montane	Early	3	5	23
6	Montane	Early	4	1	5
6	Montane	Early	5	3	14
6	Montane	Mid	1	4	18
6	Montane	Mid	2	1	5
6	Montane	Mid	3	5	23
6	Montane	Mid	5	12	55
6	Montane	Late	1	16	73
6	Montane	Late	3	2	9
6	Montane	Late	5	4	18
6	Subalpine	Early	1	1	5
6	Subalpine	Early	2	1	5
6	Subalpine	Early	3	5	23
6	Subalpine	Early	5	6	27

Forest Theme Membership	Terrestrial Community Types		Departure Class	Subbasin Count	Theme Area Percent
	Elevation Setting	Seral Status			
6	Subalpine	Mid	1	5	23
6	Subalpine	Mid	2	1	5
6	Subalpine	Mid	3	4	18
6	Subalpine	Mid	4	1	5
6	Subalpine	Mid	5	4	18
6	Subalpine	Late	1	8	36
6	Subalpine	Late	2	3	14
6	Subalpine	Late	3	3	14
6	Subalpine	Late	5	2	9

Sign Changed to Simplify Interpretation



Theme 1



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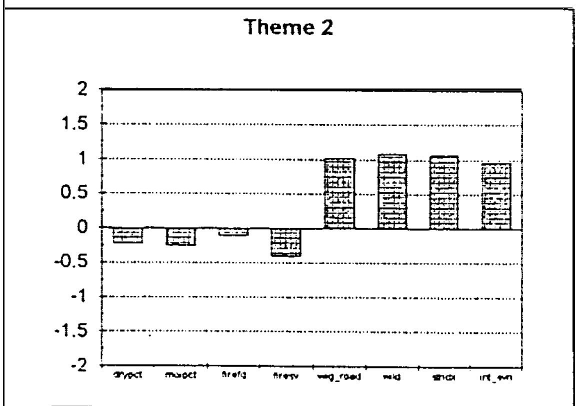

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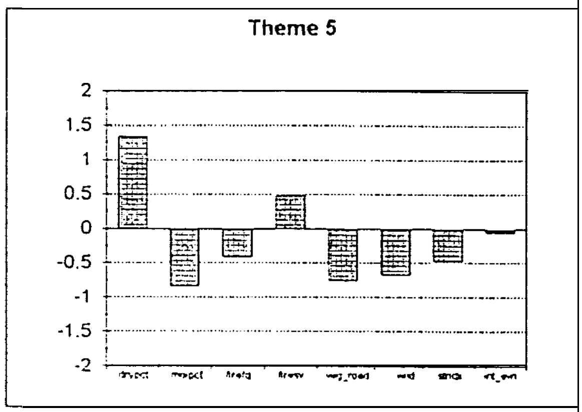
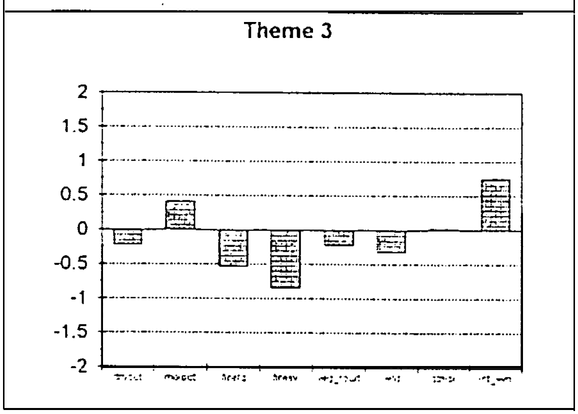


Theme 5



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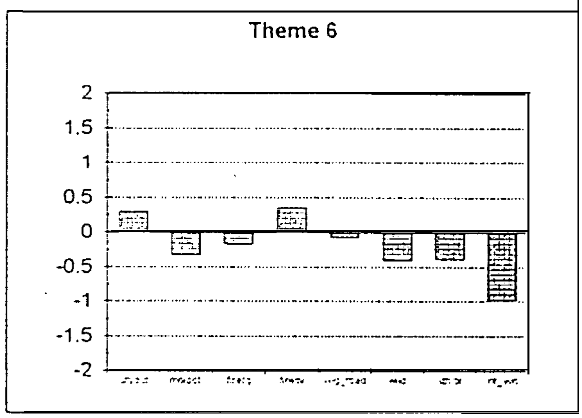

Theme 6

C:\QPW\theme.wb1

		1	2	3	4	5	6
drypct	0	-0.97	-0.23	-0.22	-0.91	1.34	0.3
moipct	0	-0.28	-0.26	0.42	1.3	-0.84	-0.33
firefq	-1	1.2	-0.11	-0.53	0.41	-0.41	-0.17
firesv	-1	0.47	-0.41	-0.85	-0.25	0.48	0.36
veg_road	-1	1.87	1.02	-0.22	-0.75	-0.75	-0.08
wild	0	1.97	1.09	-0.32	-0.57	-0.67	-0.41
stridx	0	0.97	1.07	0.03	-0.5	-0.47	-0.39
int_evn	0	0.39	0.96	0.76	-0.41	-0.06	-0.99

[redacted]

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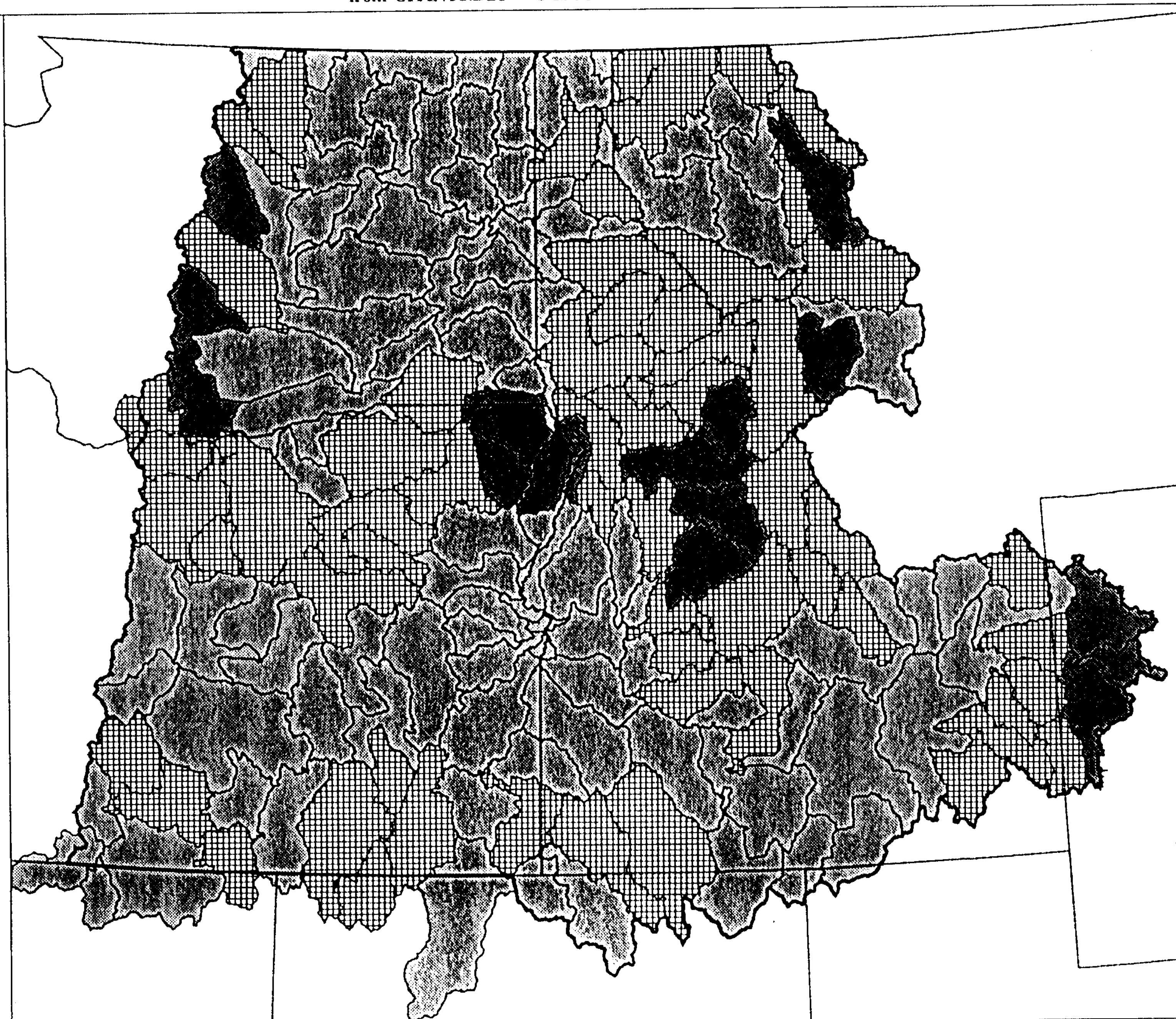
AQUATIC CLASSES by 4th FIELD HUC

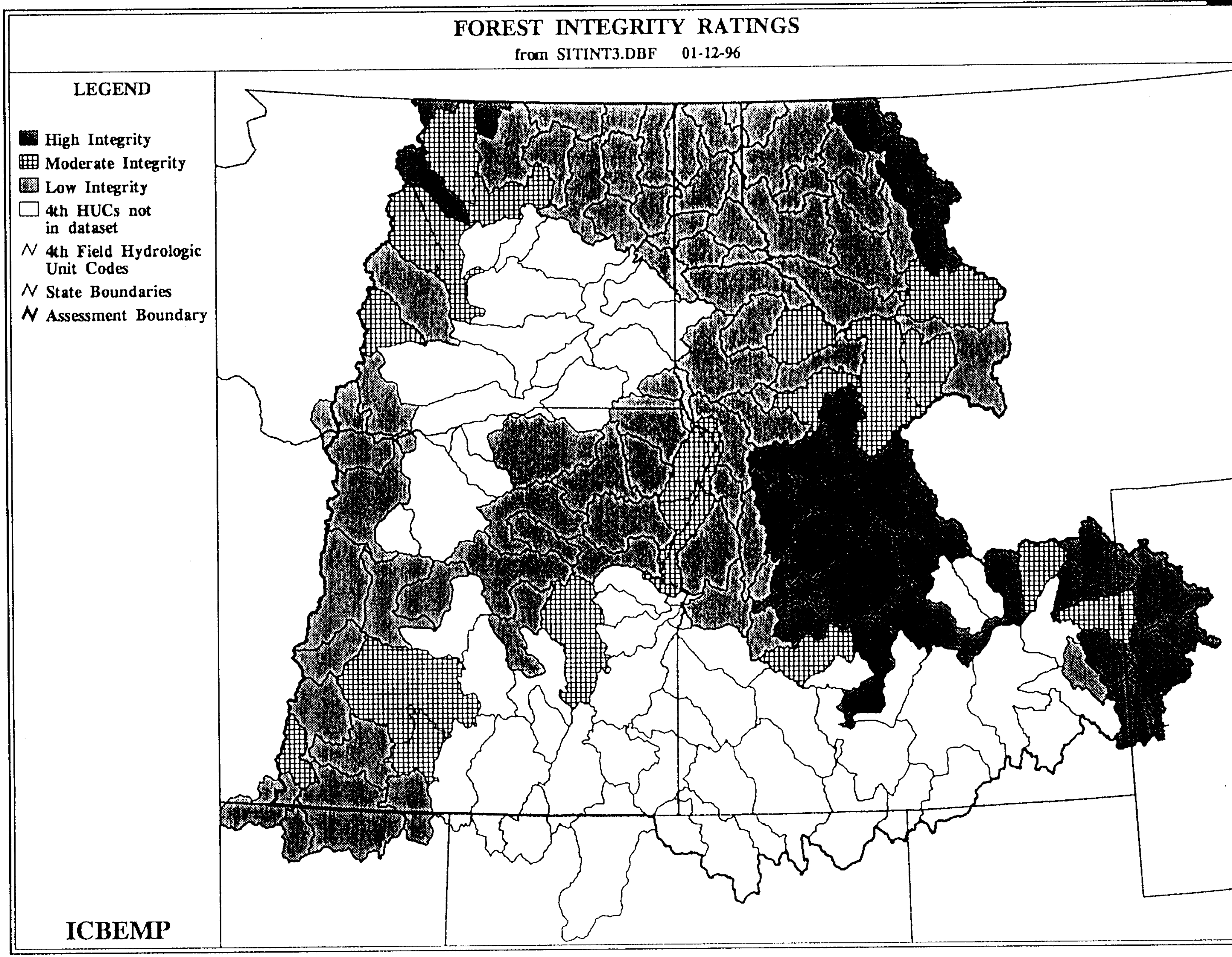
from SITINT3.DBF 1-12-96

LEGEND

- Class 1
- Class 2
- Class 3
- State Boundaries
- Assessment Boundary

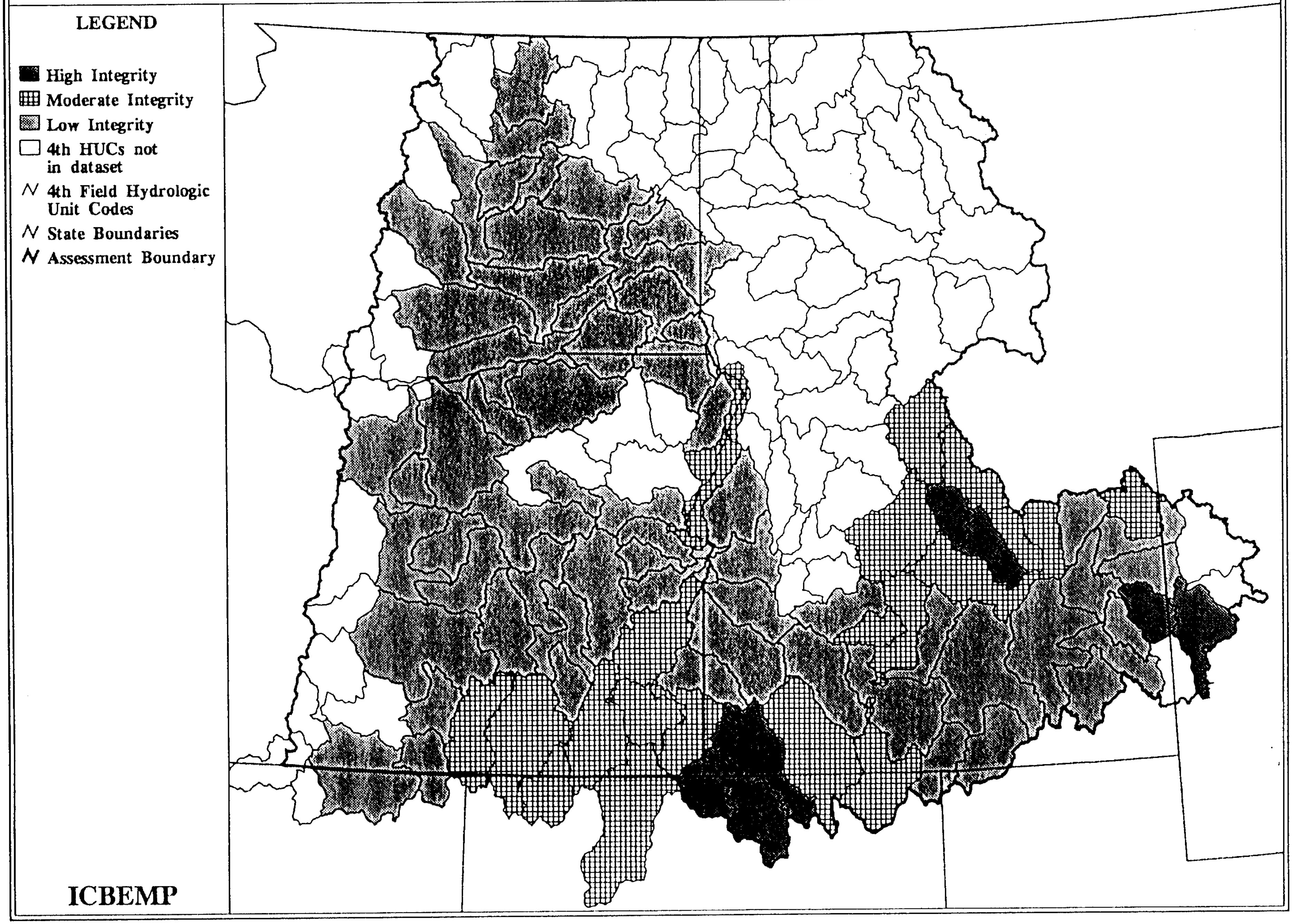


ICBEMP


FOREST INTEGRITY RATINGS
from SITINT3.DBF 01-12-96
LEGEND
High Integrity
Moderate Integrity
Low Integrity
4th HUCs not in dataset
4th Field Hydrologic Unit Codes
State Boundaries
Assessment Boundary
ICBEMP

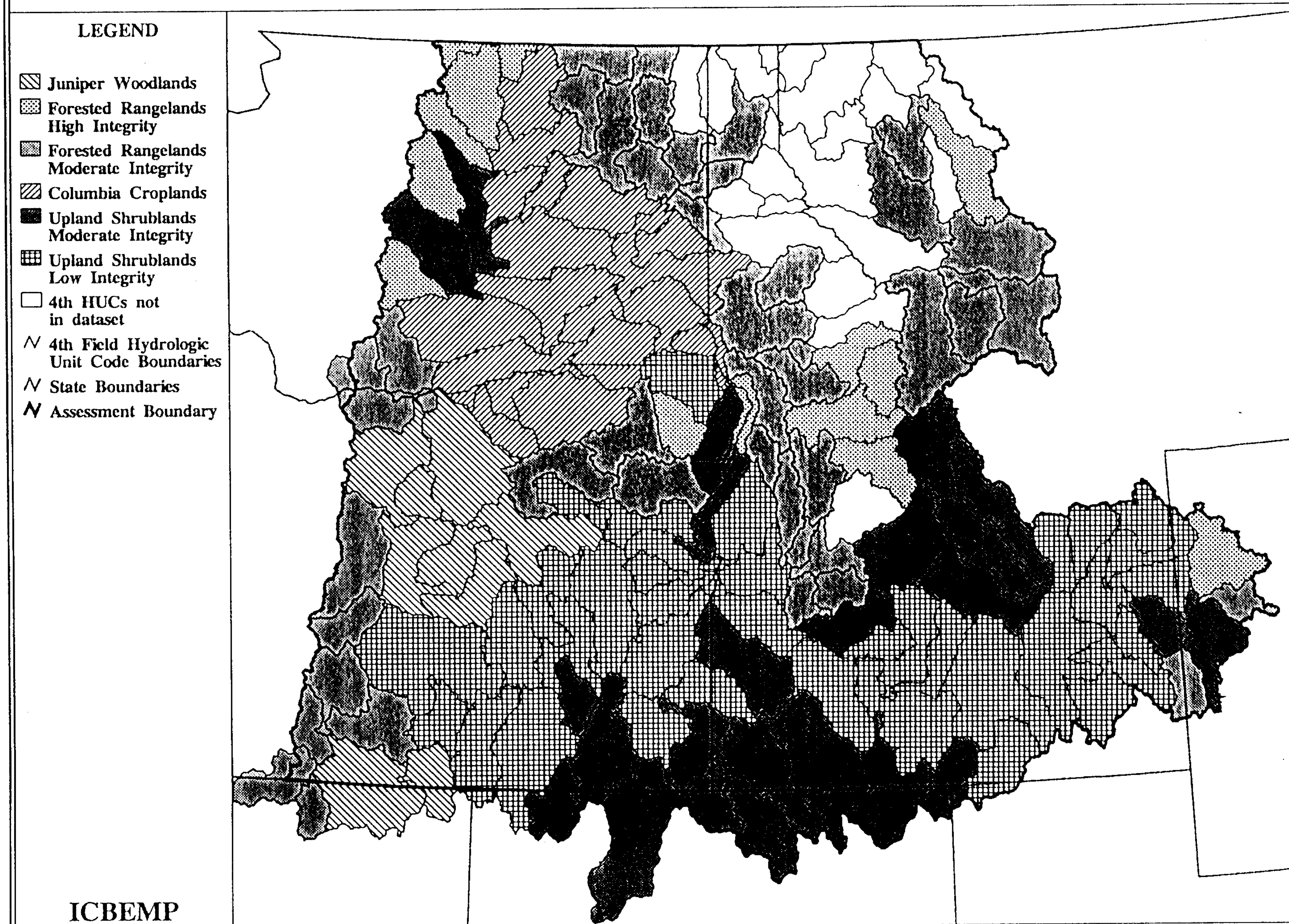
RANGE INTEGRITY RATINGS

from SITINT3.DBF 01-12-96



RANGE CLUSTERS (THEMES)

from SITINT4.DBF 01-17-96



FOREST THEMES

from SITINT3.DBF 01-12-96